# Physiotherapy and other Components of PR

## - Evidence Update -

Mar 10, 2018

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# Contents

- Overview on Chest Physiotherapy(CPT)/ Airway Clearance Therapy(ACT)
- Clinical Evidence of Airway Clearance Therapy in Respiratory Diseases
  - Bronchiectasis
  - COPD
- Details and Clinical Evidence of Each Technique
- Other Approaches

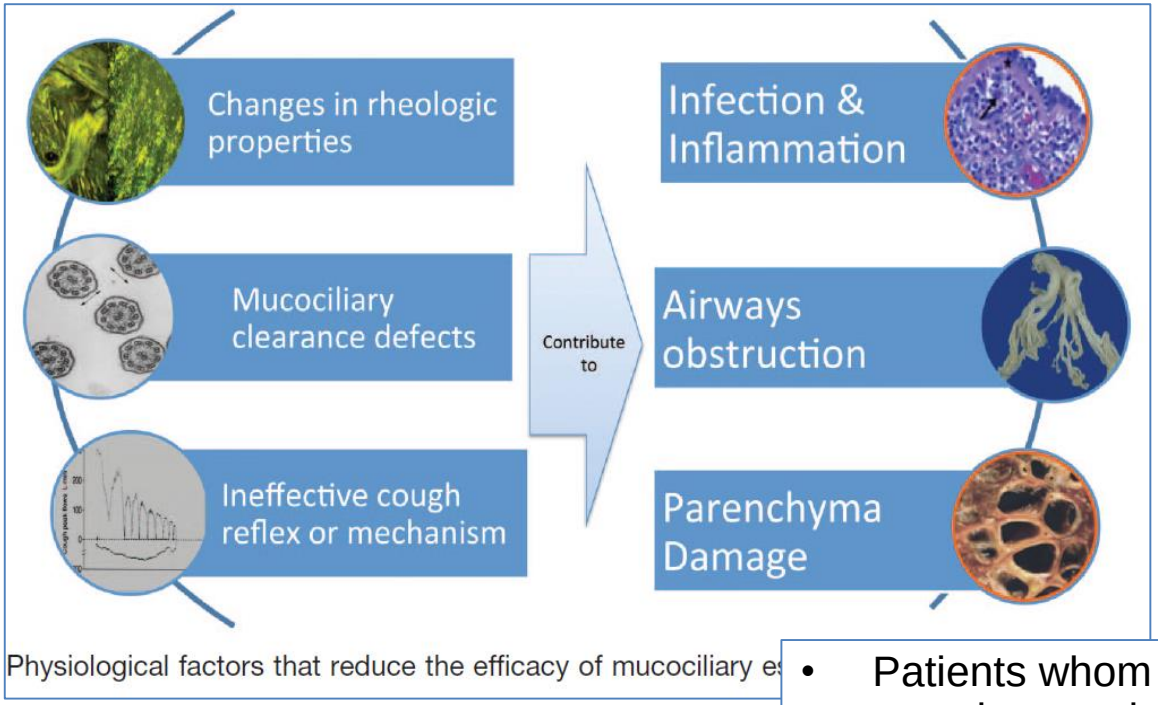
*No conflict of interests with devices companies presented in this lecture

# Chest physiotherapy (CPT)

- Technique used to mobilized or loose secretions in the lugs and respiratory tract.

  - External mechanical maneuvers
    - Chest percussion
    - Postural drainage
    - Vibration to augment mobilization and clearance of airway secretions
    - Diaphragmatic breathing with pursed-lips
    - Coughing and controlled coughing

# Indications of CPT

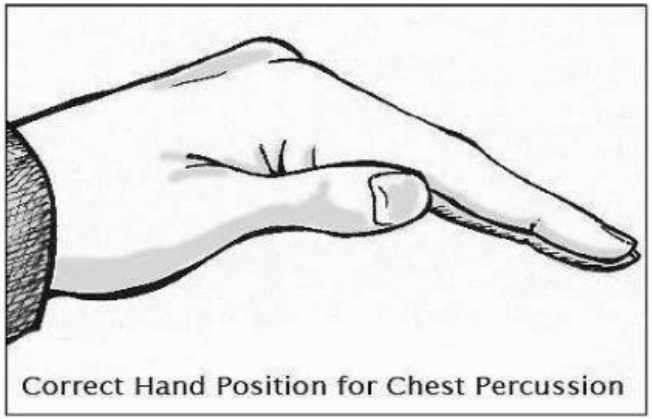



Physiological factors that reduce the efficacy of mucociliary es

- Patients whom cough is insufficient to clear thick, tenacious, or localized secretions like,
  - Cystic fibrosis
  - Bronchiectasis
  - Atelectasis
  - Lung abscess
  - Neuromuscular diseases
  - Pneumonia in dependent lung regions
  - Etc.

# Percussion

- Vigorously striking the chest wall alternatively
  - Hollow sound, rhythmically
  - Should not be painful
  - Over a single layer of clothing, not over buttons or zippers
  - 30-60 seconds  for each area, several times a day
    - 3-5minutes for tenacious secretions


Correct Hand Position for Chest Percussion

# Vibration

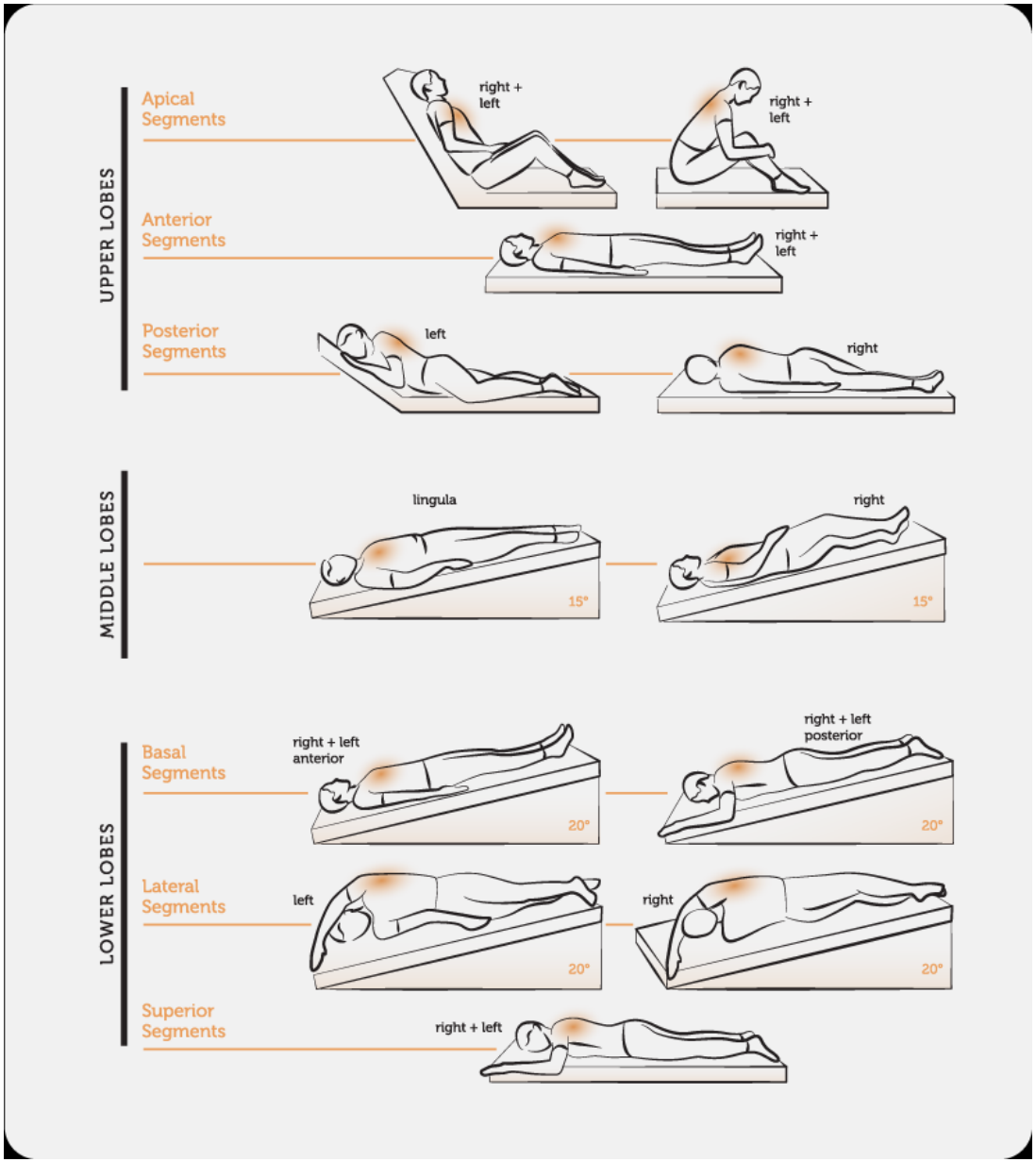
- Rhythmic contractions and relaxations of arms and shoulder muscles over the patient's chest
- During vibration, place your flat hand firmly against the chest wall
- Vibrate the chest wall as the patients exhales slowly through the pursed lips
- After each vibration, encourage for coughing and expectorating secretions

# Postural drainage

- Two or three times daily
- Before breakfast, before lunch, late afternoon, before bedtime
- Avoid hours shortly after meals

- 10-15 minutes in the desired position, if tolerated

- Combined with percussion and vibration
  - Positioning, percussion, vibration, removal of secretion by coughing or suction



# Chest physiotherapy

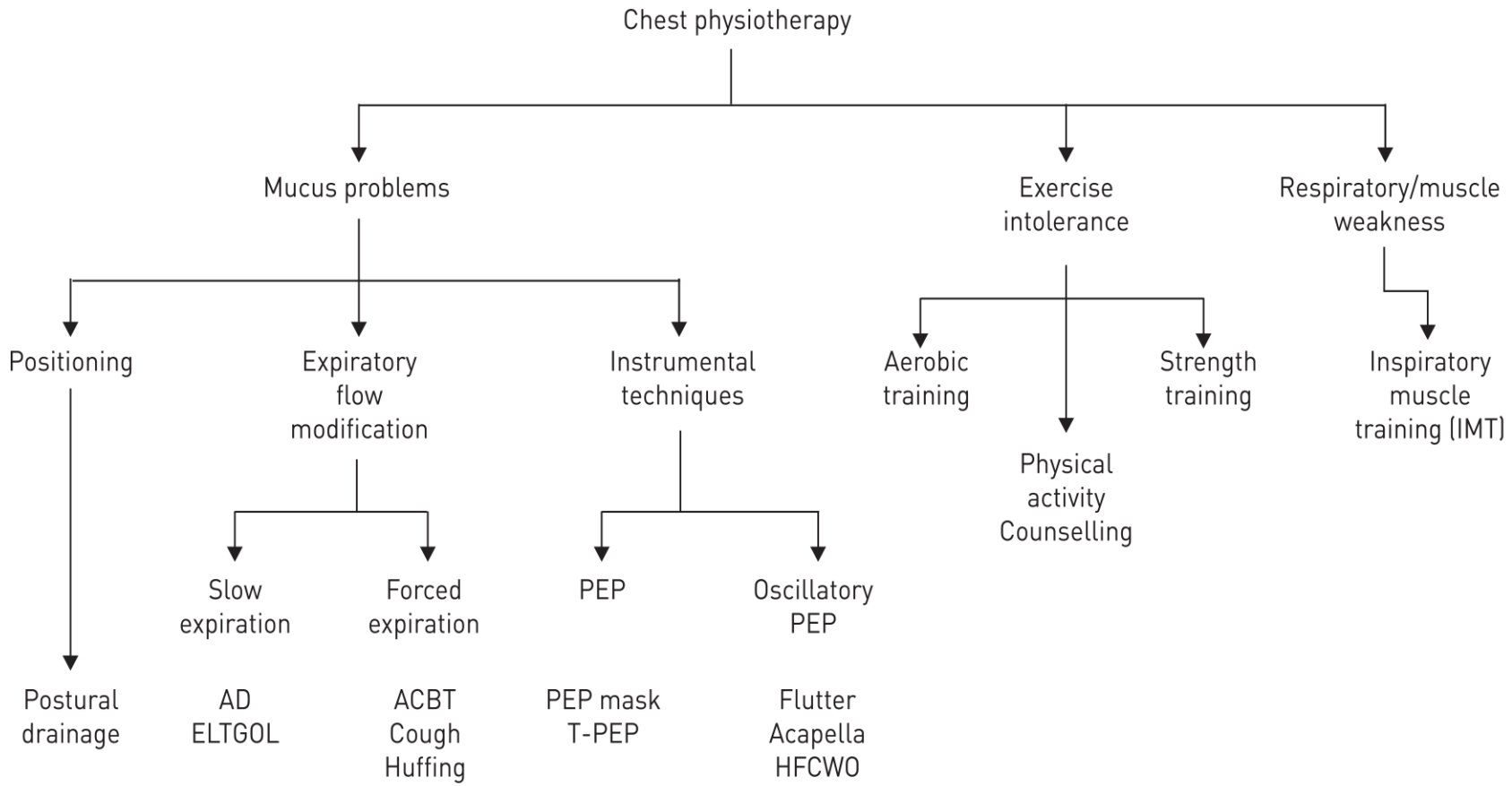



FIGURE 6 Chest physiotherapy interventions flow chart based on clinical experience from the task force panel. AD: autogenic drainage; ELTGOL: total slow expiration with open glottis and infralateral position; ACBT: active cycle of breathing techniques; PEP: positive expiratory pressure; T-PEP: temporary positive expiratory pressure; HFCWO: high frequency chest wall oscillation.

Eur Respir J 2017; 50: 1700629

# Physiological basis for airway clearance therapy

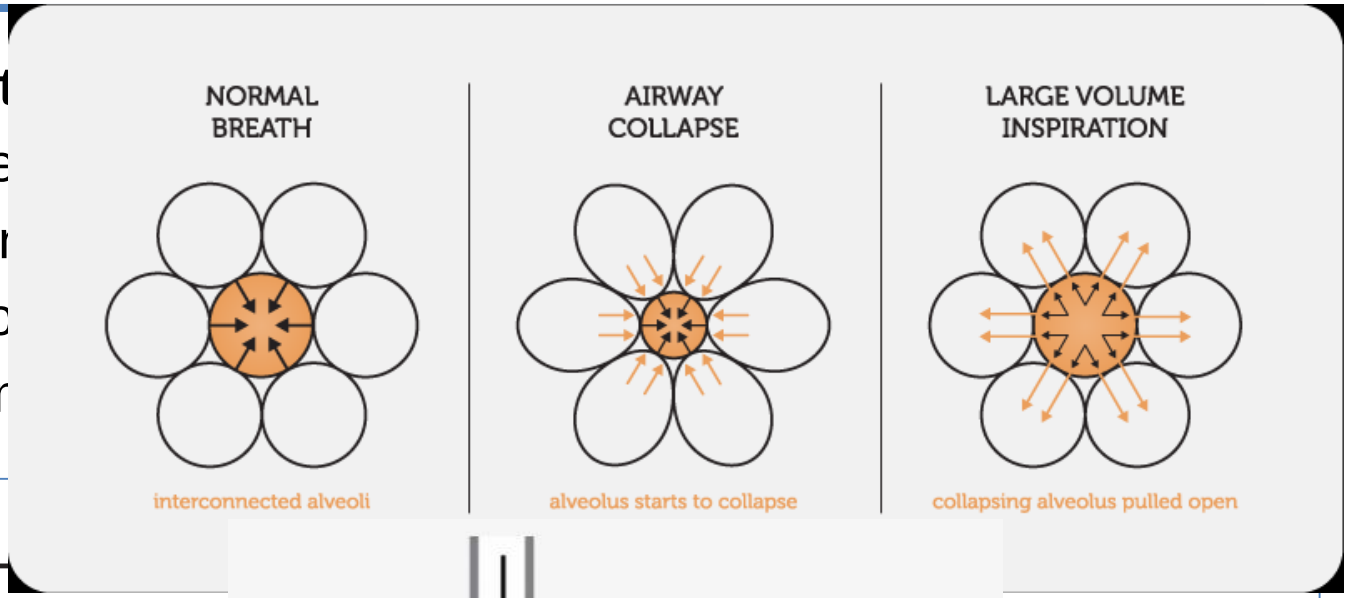
# Background of ACT

- To supplement the body's mucociliary clearance system when it is impaired by diseases

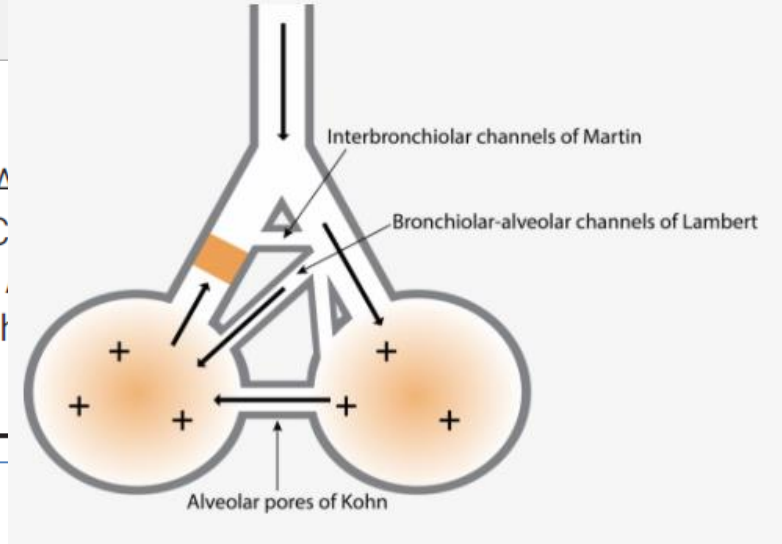
- Two physiological principles
  - **Optimizing ventilation to obstructed regions of the lung**
  - **Utilizing expiratory airflow to enhance secretion removal**

# Background of ACT

- **Optimizing vent**
  - Interdepende
  - Collateral ve
  - 3-s breath ho
  - Positioning, r




| | |
|---|---|
| Secretions in upper lobes | |
| Secretions in middle lobe and lingula | |
| Secretions in right lung | |
| Secretions in left lung | |
| Secretions in lower lobes | |




Eur Respir Rev **2017; 26: 160086**

# Background of ACT

- **Utilizing expiratory airflow to enhance secretion removal**
  - Cough
  - Huff/forced expiratory maneuver
  - Two-phase gas-liquid flow mechanism
    - Oscillation
    - Vibration

| | Subjects n | PEFR L·min$^{-1}$ | PIFR L·min$^{-1}$ | PEFR/PIFR ratio | Frequency Hz |
|---|---|---|---|---|---|
| **Huff** | 17 | 302.4±121.8 | 124.8±85.2 | 2.80 | |
| **Cough** | 17 | 280.2±114.6 | 100.8±44.4 | 3.07 | |
| **Vibration** | 17 | 94.8±43.8 | 63.6±16.2 | 1.51 | 8.4±0.4 |
| **Autogenic drainage** | 14 | 85.2±28.8 | 50.4±13.8 | 1.69 | |
| **Flutter** | 17 | 67.8±18.0 | 63.0±16.2 | 1.15 | 11.3±1.5 |
| **Percussion** | 18 | 49.8±8.4 | 50.4±6.0 | 0.99 | 7.3±0.3 |
| **Acapella** | 18 | 35.4±4.8 | 58.8±16.2 | 0.64 | 13.5±1.7 |
| **PEP** | 18 | 26.4±9.0 | 57.6±12.0 | 0.47 | |

Data are presented as n or mean±SD. Data from [49–51]. PEFR: peak expiratory flow rate; PIFR: peak inspiratory flow rate; PEP: positive expiratory pressure.

Eur Respir Rev **2017; 26: 16008**

# Chest physiotherapy

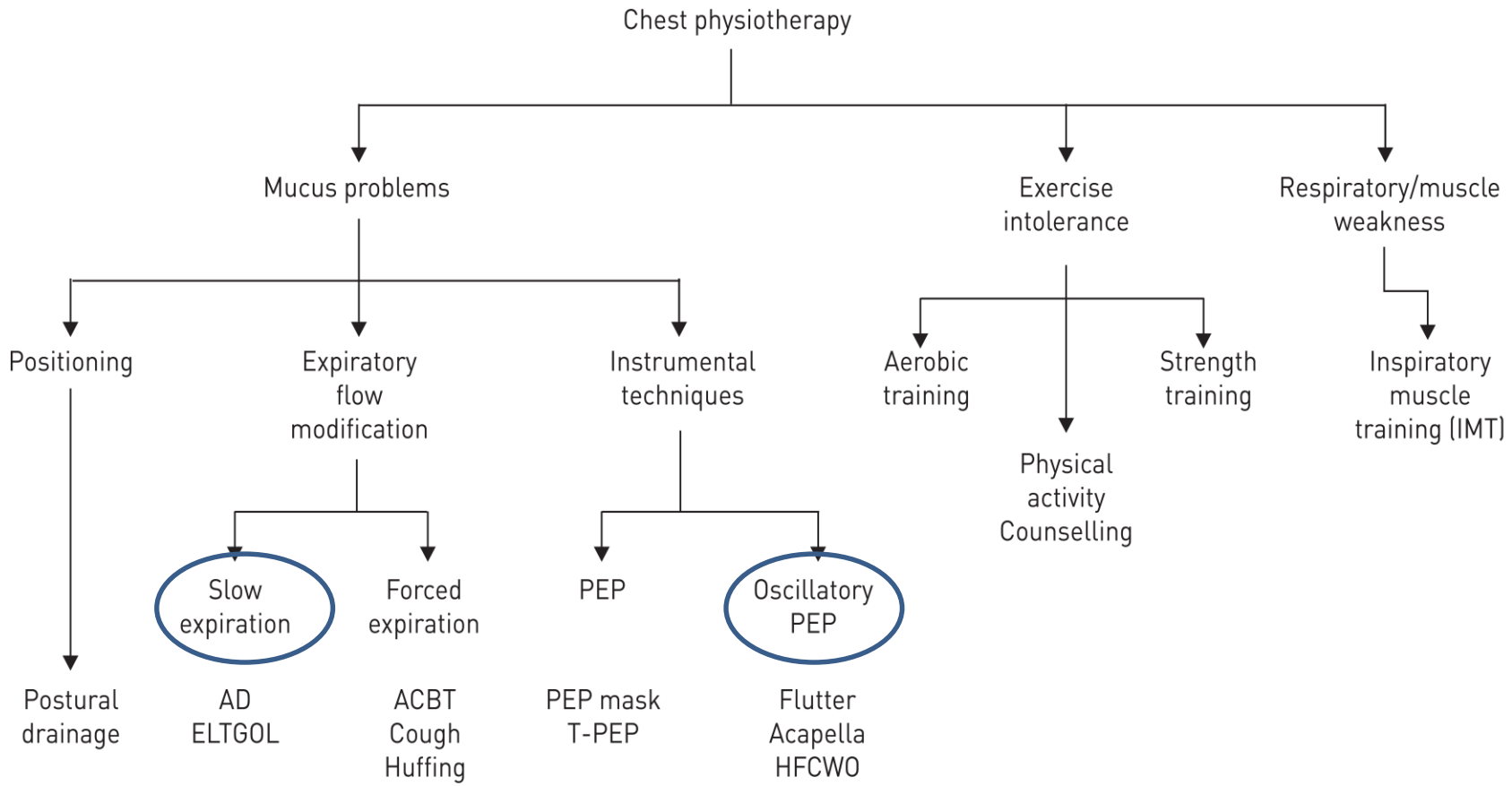



FIGURE 6 Chest physiotherapy interventions flow chart based on clinical experience from the task force panel. AD: autogenic drainage; ELTGOL: total slow expiration with open glottis and infralateral position; ACBT: active cycle of breathing techniques; PEP: positive expiratory pressure; T-PEP: temporary positive expiratory pressure; HFCWO: high frequency chest wall oscillation.

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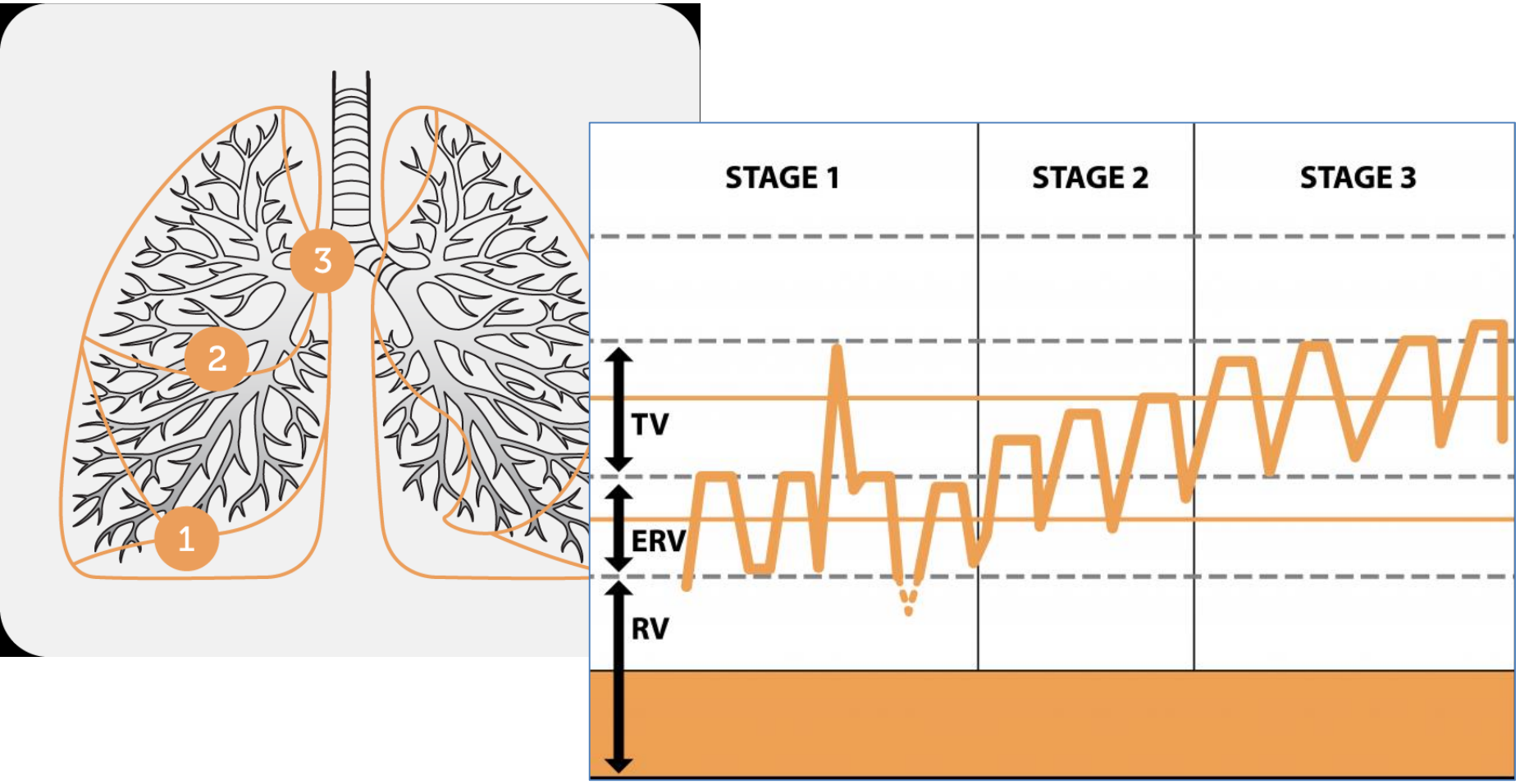
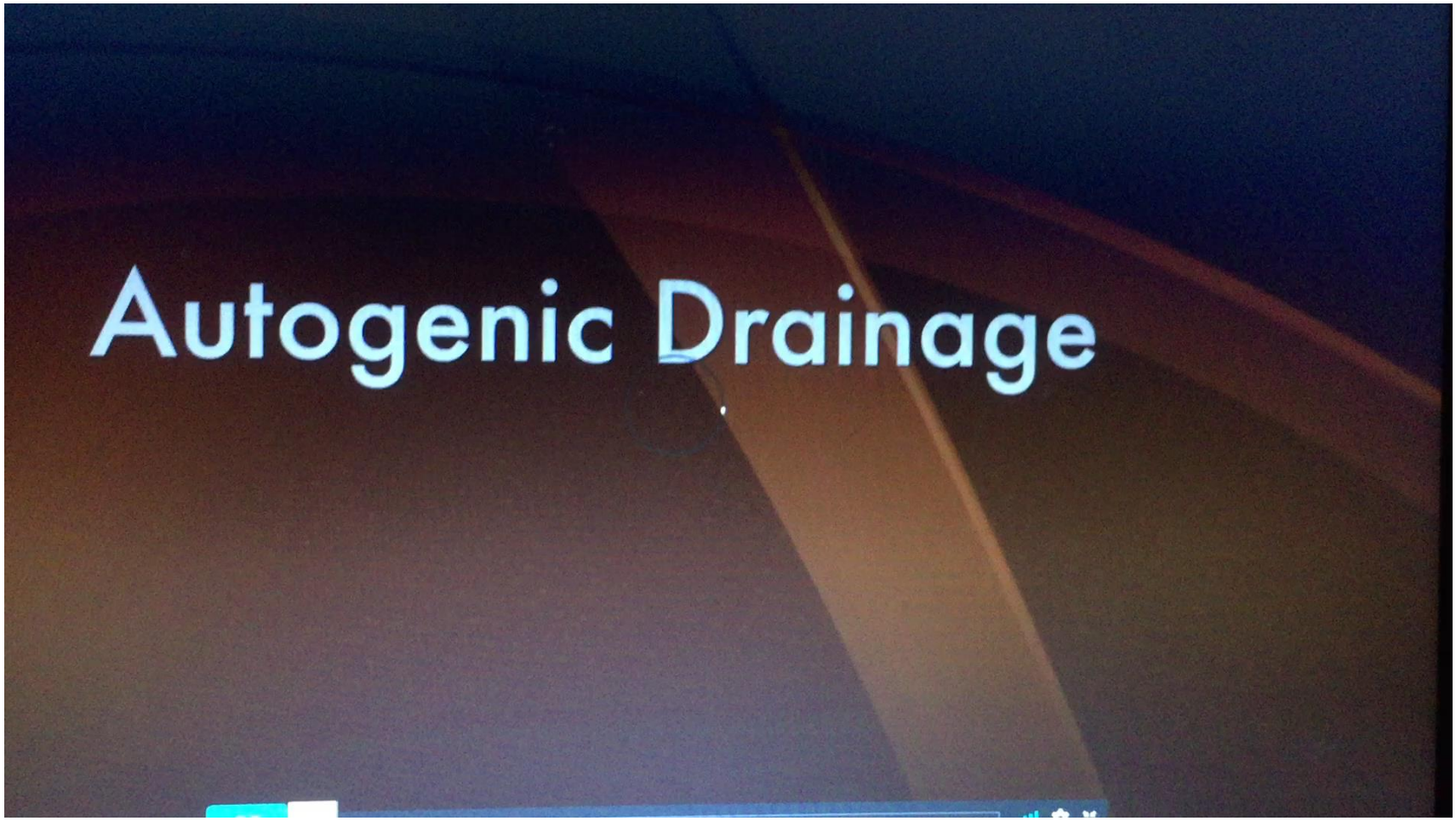
# Autogenic Drainage




Stage 1 – low volume breaths to mobilise secretions from the peripheral airways
Stage 2 – medium (tidal) volume breaths to collect mucus from the middle airways
Stage 3 – large volume breaths enabling expectoration from central airways

http://bronchiectasis.com.au/physiotherapy

# Autogenic Drainage

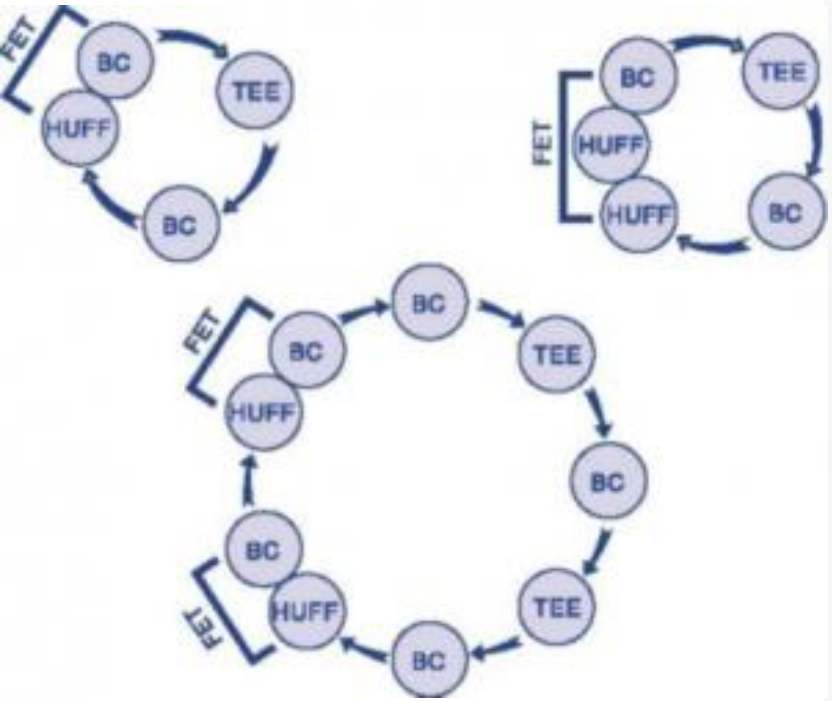


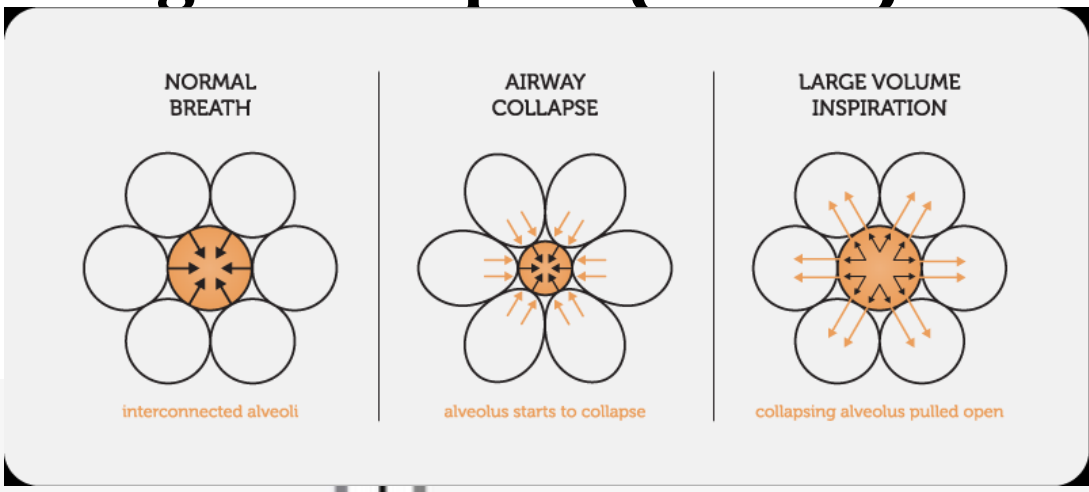

http://bronchiectasis.com.au/physiotherapy

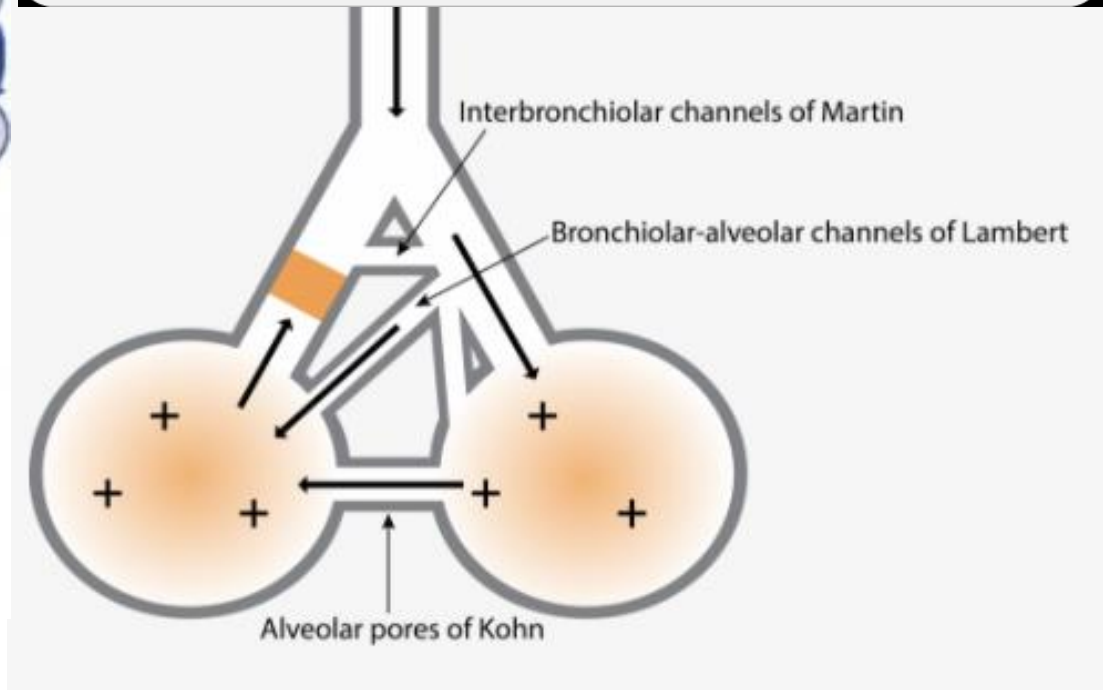
Expiratory flow modification → Forced expiration

# Active Cycle of Breathing Techniques (ACBT)

- breathing control
- thoracic expansion exercises
- huffing



# Forced Expiratory Technique (FET)/Active Cycle of Breathing Techniques (ACBT)

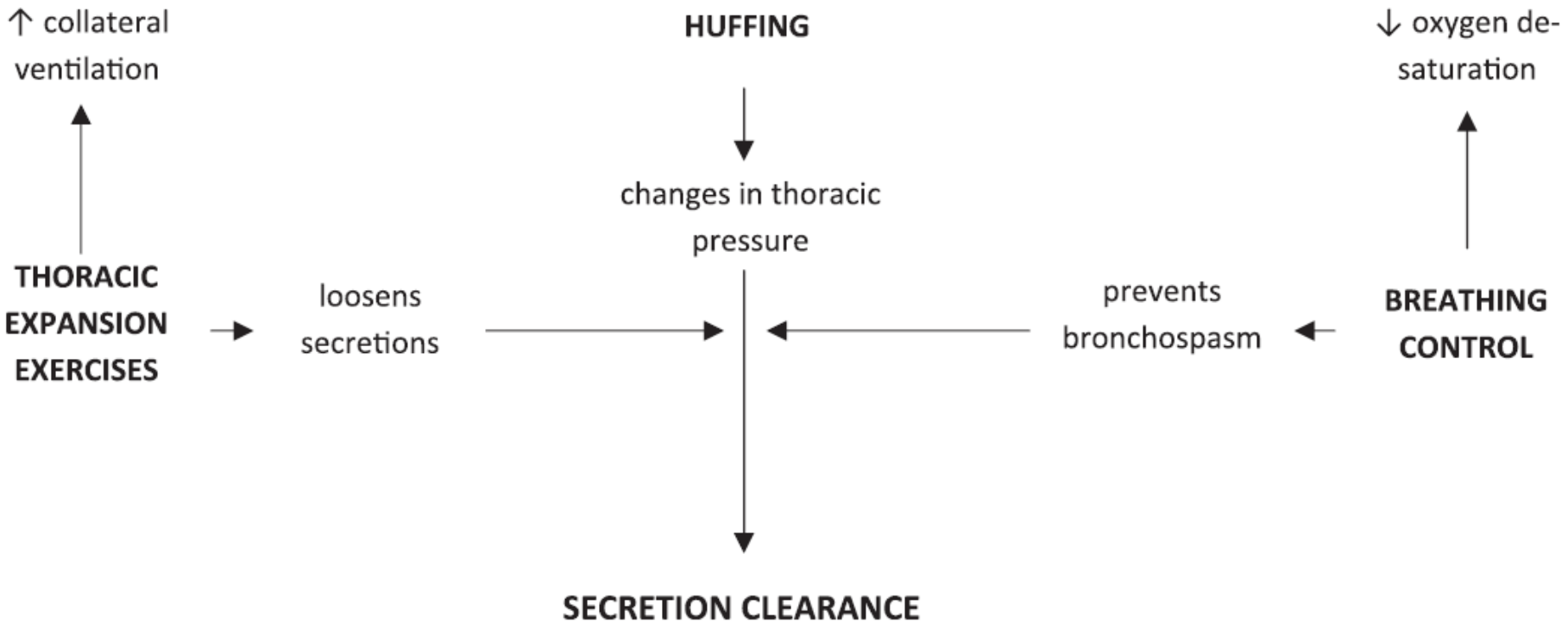
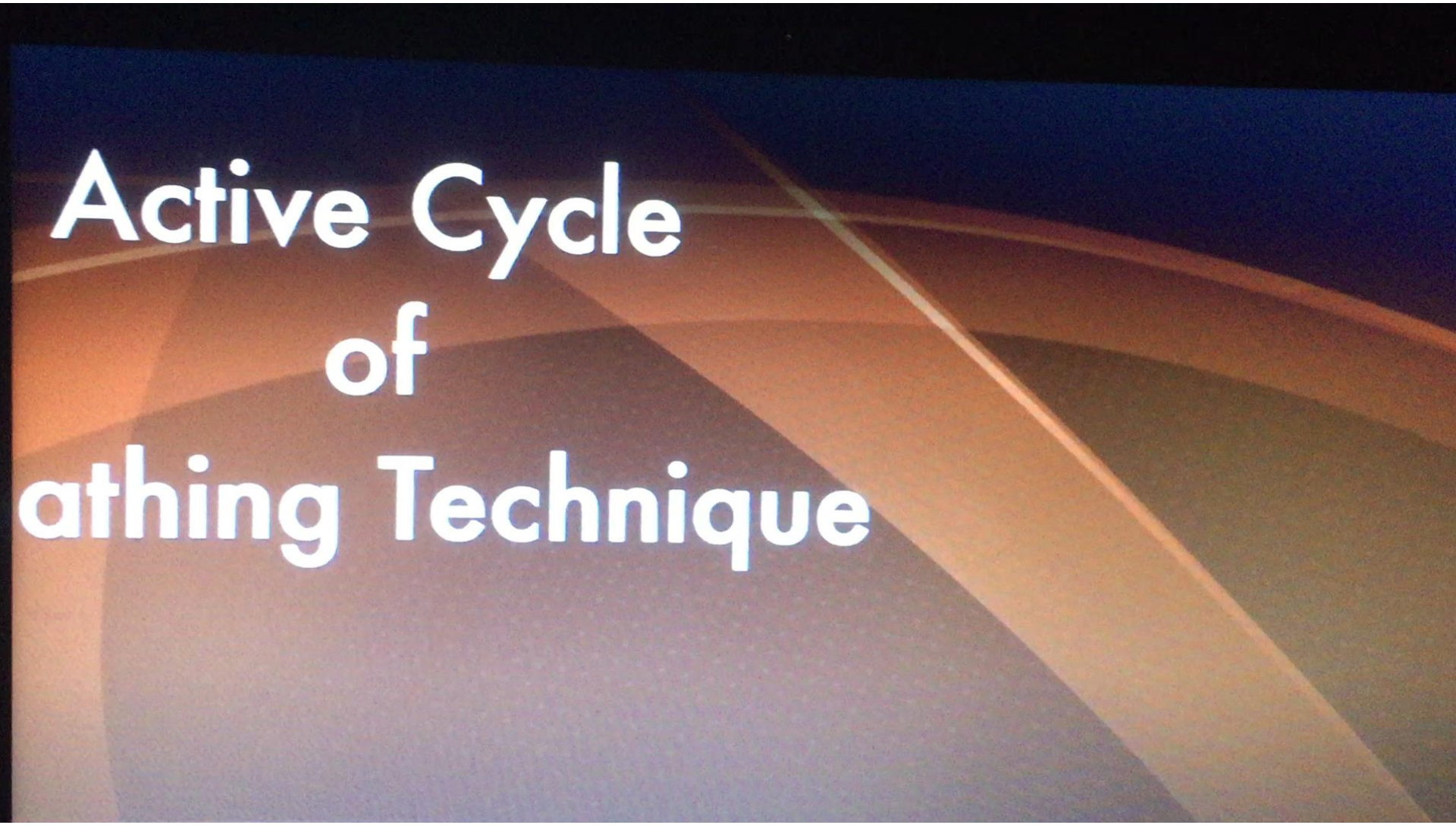



**Figure 1** Proposed mechanisms by which FET/ACBT results in secretion clearance.

Respiratory Medicine (2012) 106, 155e

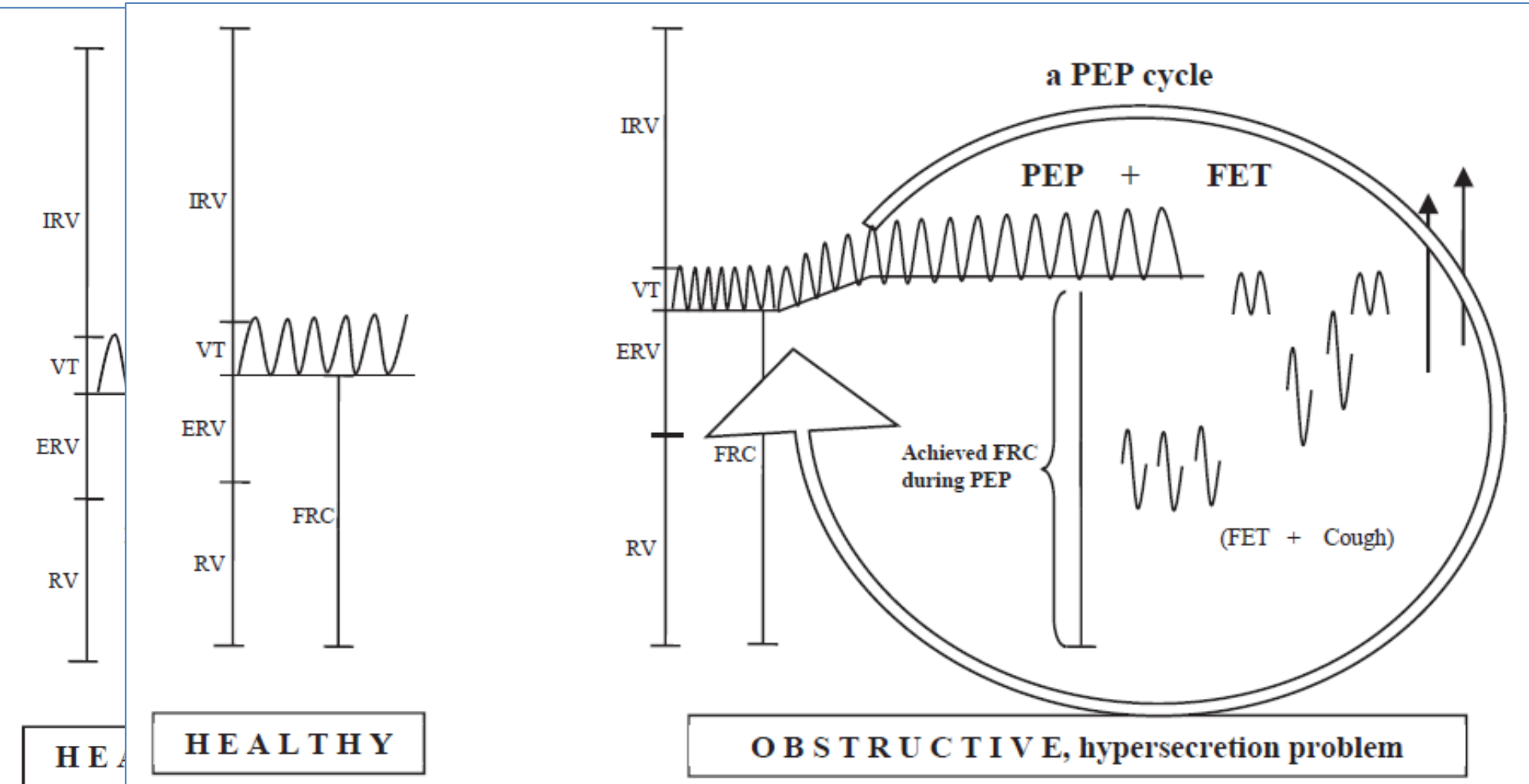
# ACBT




http://bronchiectasis.com.au/physiotherapy

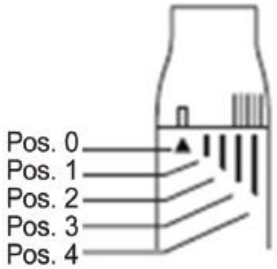
# Positive expiratory pressure (PEP) therapy

# PEP

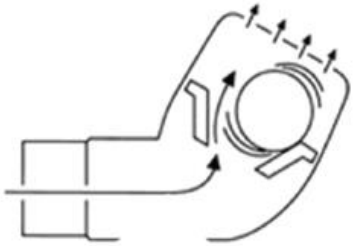

IRV
VT
ERV
RV
HEALTHY
a PEP cycle
PEP + FET
FRC
Achieved FRC
during PEP
(FET + Cough)
OBSTRUCTIVE, hypersecretion problem

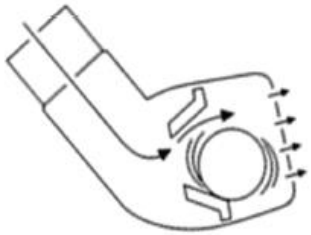
# Oscillating Positive Expiratory Pressure (PEP) thera

RC-Cornet

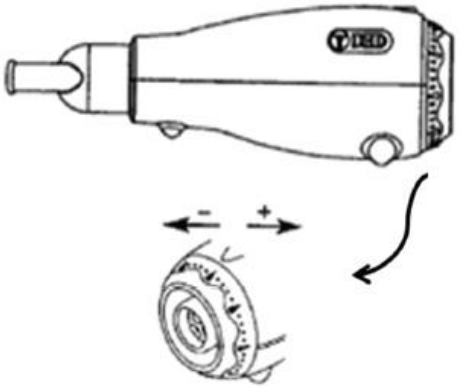



Flutter





Acapella



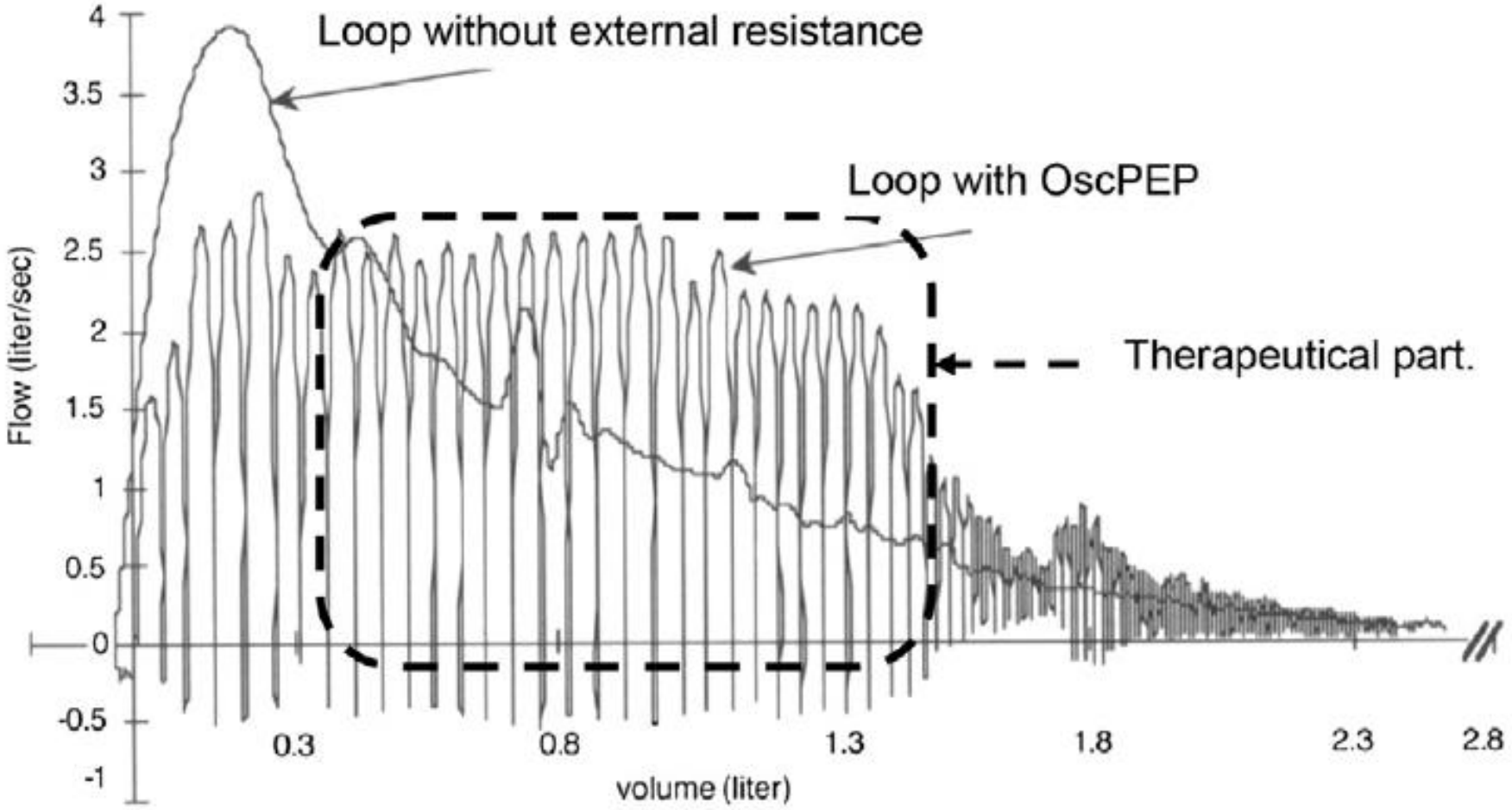

High-frequency oscillations and PEP are created as exhaled gas passes through a cone, which is intermittently occluded by a plug attached

Aerobika

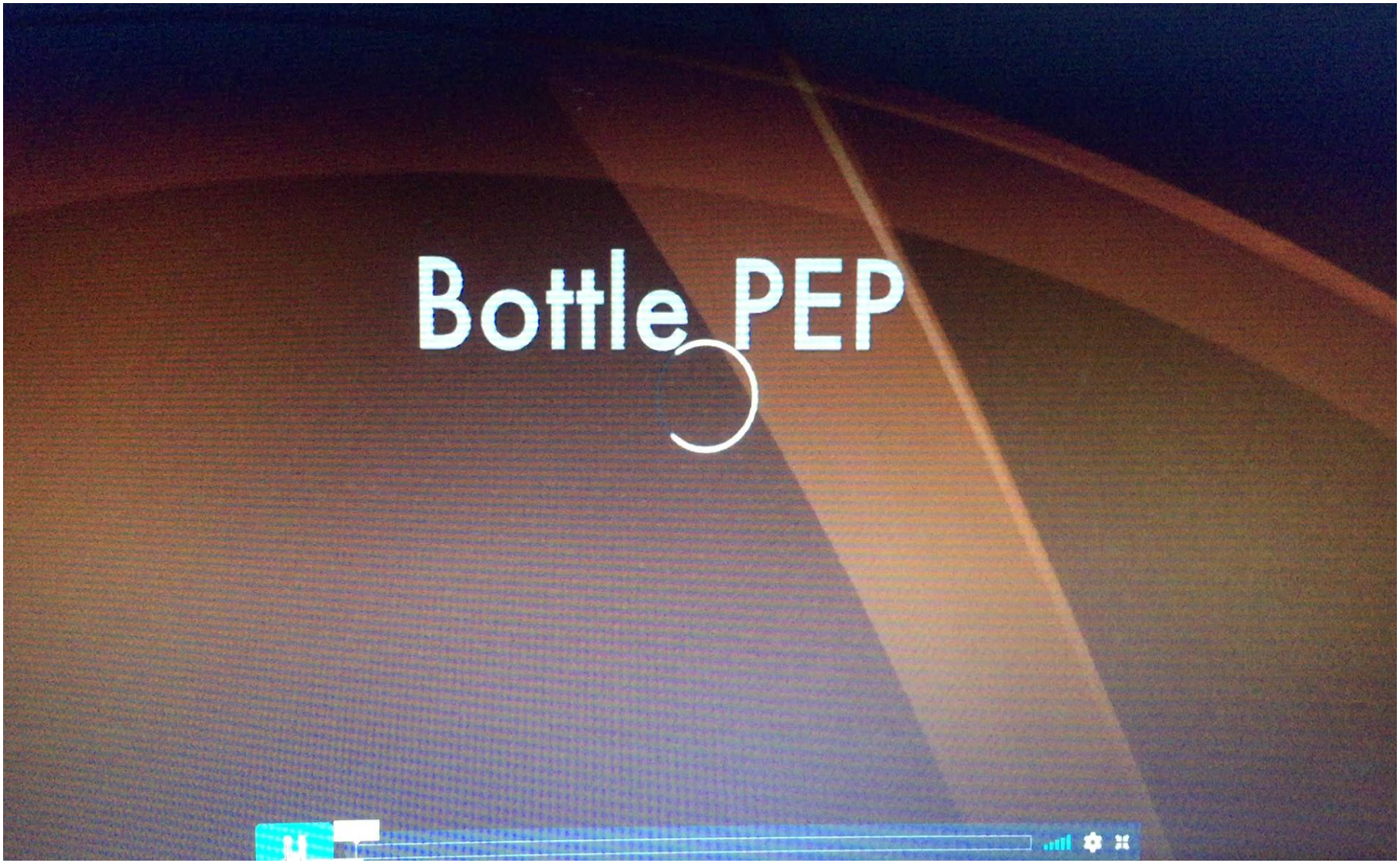


Respir Care 2017;62(4):451–458

# Oscillating PEP



# Bottle PEP




http://bronchiectasis.com.au/physiotherapy

# Is Airway Clearance Therapy Beneficial? & To What patients ?

**BRONCHIECTASIS**
**COPD**

# Measuring Clinical Impact of Airway Clearance Technique

- Sputum wet weight
  - Short term outcomes of interventions
  - Day to day variability, inaccuracy associated with underestimation or overestimation
- FVC, FEV1
- Exercise tolerance
- QoL
- Exacerbation

Cochrane Library

Cochrane Database of Systematic Reviews

Lee AL, Burge AT, Holland AE.
Airway clearance techniques for bronchiectasis.
Cochrane Database of Systematic Reviews 2015, Issue 11. Art. No.: CD008351

| Outcomes | Illustrative comparative risks* (95% CI) | | Relative effect (95% CI) | Number of participants (studies) | Quality of the evidence (GRADE) | Comments |
|---|---|---|---|---|---|---|
| | Assumed risk | Corresponding risk | | | | |
| | Control | Airway clearance techniques (ACTs) | | | | |
| **Number of exacerbations of bronchiectasis** Frequency of acute exacerbations of bronchiectasis Follow-up: mean 3 months | **35 per 100**[a] | **25 per 100** (8 to 79)[a] | **RR 0.71** (0.23 to 2.25) | 20 (1 study) | ⊕⊕◯◯ **low**[b,c] | Duration of each intervention was 3 months of PEP-based ACT |
| **Hospitalisations** | See comment | See comment | See comment | See comment | See comment | Not reported |
| **Health-related quality of life (disease-specific)** Scale from 0 to 100; lower score indicates better HRQoL. SGRQ total score consists of weighted scores from 3 domains Follow-up: mean 3 months | Median health-related quality of life (disease-specific) in control groups was **-0.7 points**[a] | Median health-related quality of life (disease-specific) in intervention groups was **7.5 lower**[a] | | 20 (1 study) | ⊕⊕◯◯ **low**[b,d] | Lower score post intervention was favourable, indicating improvement in HRQoL |

Cochrane Library

Cochrane Database of Systematic Reviews

| | | | | | | |
|---|---|---|---|---|---|---|
| **Health-related quality of life (cough-specific)** Leicester Cough Questionnaire Scale from 0 to 133; higher score indicates better HRQoL. Contains 19 questions from 3 domains on a Likert scale Follow-up: mean 3 months | Median HRQoL (cough-specific) in control groups was **0.0 points**[a] | Median HRQoL (cough-specific) in intervention groups was **1.3 higher**[a] | | 20 (1 study) | ⊕⊕◯◯ **low**[b,e] | Higher score post intervention was favourable, indicating improvement in HRQoL cough-related |
| **Health-related quality of life (health status)** COPD Assessment Tool. Scale from 0 to 5; higher score indicates worse HRQoL Contains 1 with 5-point Follow-up: days | Mean health status score in control group was **9.9 points** | Mean health status score in intervention groups was **14.8 points lower (11.6 to 18 points lower)** | **MD -14.8 (95% CI -18.0 to -11.6)** | 30 (1 study) | ⊕⊕◯◯ **low**[b,e] | Two interventions (high-frequency chest wall oscillation and mixed ACTs) compared with control. Lower score |
| **Respiratory (symptoms** Breathlessn and Sput Scale from Lower sco fewer symp Follow-up: days | | | | | | |

**HFCWO** improved FEV1 by 156 mL and FVC by 229.1 mL when applied for 15 days, but other types of ACTs showed no effect on dynamic lung volumes.

Two studies reported a reduction in pulmonary hyperinflation among adults with **non-PEP ACTs** (difference in FRC of 19%, P value < 0.05; difference in TLC of 703 mL, P value = 0.02) and

with **airway oscillatory devices** (difference in FRC of 30%, P value < 0.05) compared with no ACTs.

# Oscillary PEP vs Control in BE

Original Article

Chronic Respiratory Disease

## The effects of oscillating positive expiratory pressure therapy in adults with stable non-cystic fibrosis bronchiectasis: A systematic review

Chronic Respiratory Disease
2015, Vol. 12(1) 36–46

DOI: 10.1177/1479972314562407
crd.sagepub.com
SAGE

In stable non-CF bronchiectasis, oscillating PEP therapy is associated with

- improvement in sputum expectoration and QOL compared to no treatment.
- Compared to other ACTs, the effect upon sputum expectoration, lung function, gas exchange, and symptoms are equivalent.

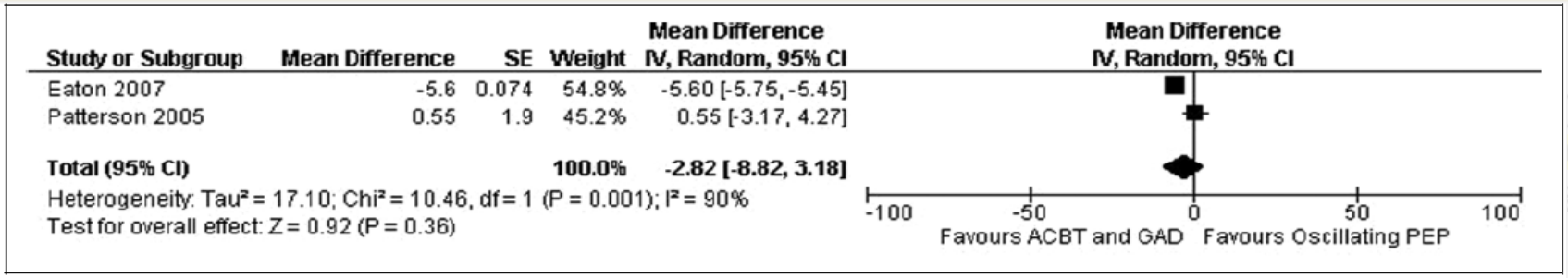
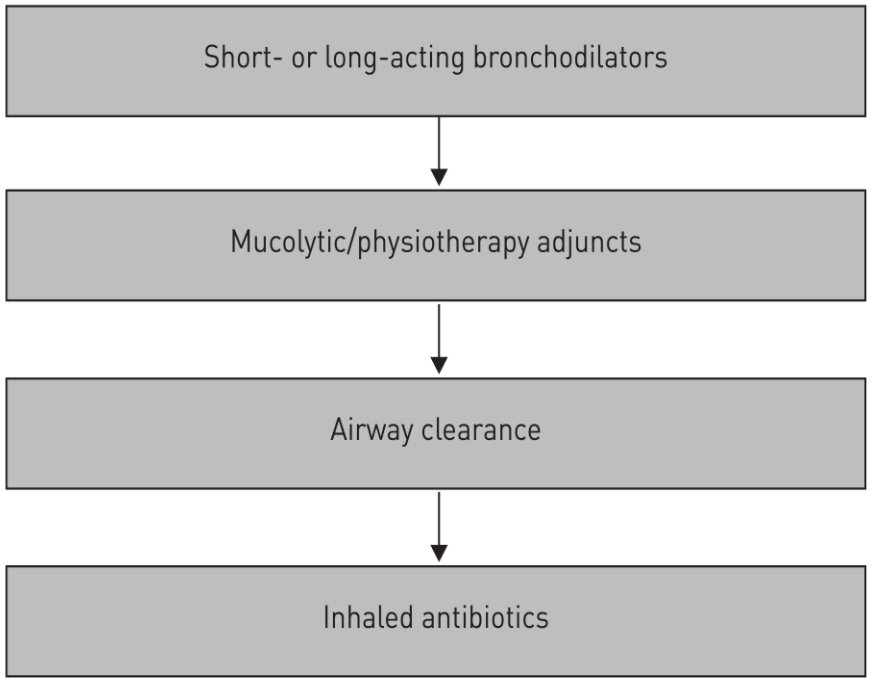



**Figure 2.** Forest plot comparing oscillating PEP to ACBT with GAD for sputum expectoration (wet weight (g)). PEP: positive expiratory pressure; ACBT: active cycle of breathing technique; GAD: gravity-assisted drainage.

# ERS guidelines for the management of adult bronchiectasis (ERS guideline 2017)




Flowchart of multiple sequential airways treatment administration in adult patients with bronchiectasis

**Question 9: Is regular physiotherapy (airway clearance and/or pulmonary rehabilitation) more beneficial than control (no physiotherapy treatment) in adult bronchiectasis patients?**

Recommendations

**- Patients with chronic productive cough or difficulty to expectorate sputum should be taught an airway clearance technique (ACT) by a trained respiratory physiotherapist to perform once or twice daily** (weak recommendation, low quality of evidence)**.**

**-Adult patients with bronchiectasis and impaired exercise capacity should participate in a pulmonary rehabilitation program and take regular exercise.**

**-All interventions should be tailored to the patient's symptoms, physical capability and disease characteristics** (strong recommendation, high quality

Eur Respir J 2017; 50: 1700629,

# Regional Abn…se to Airway …g Pulmor…ic …g

Bronchiectasis

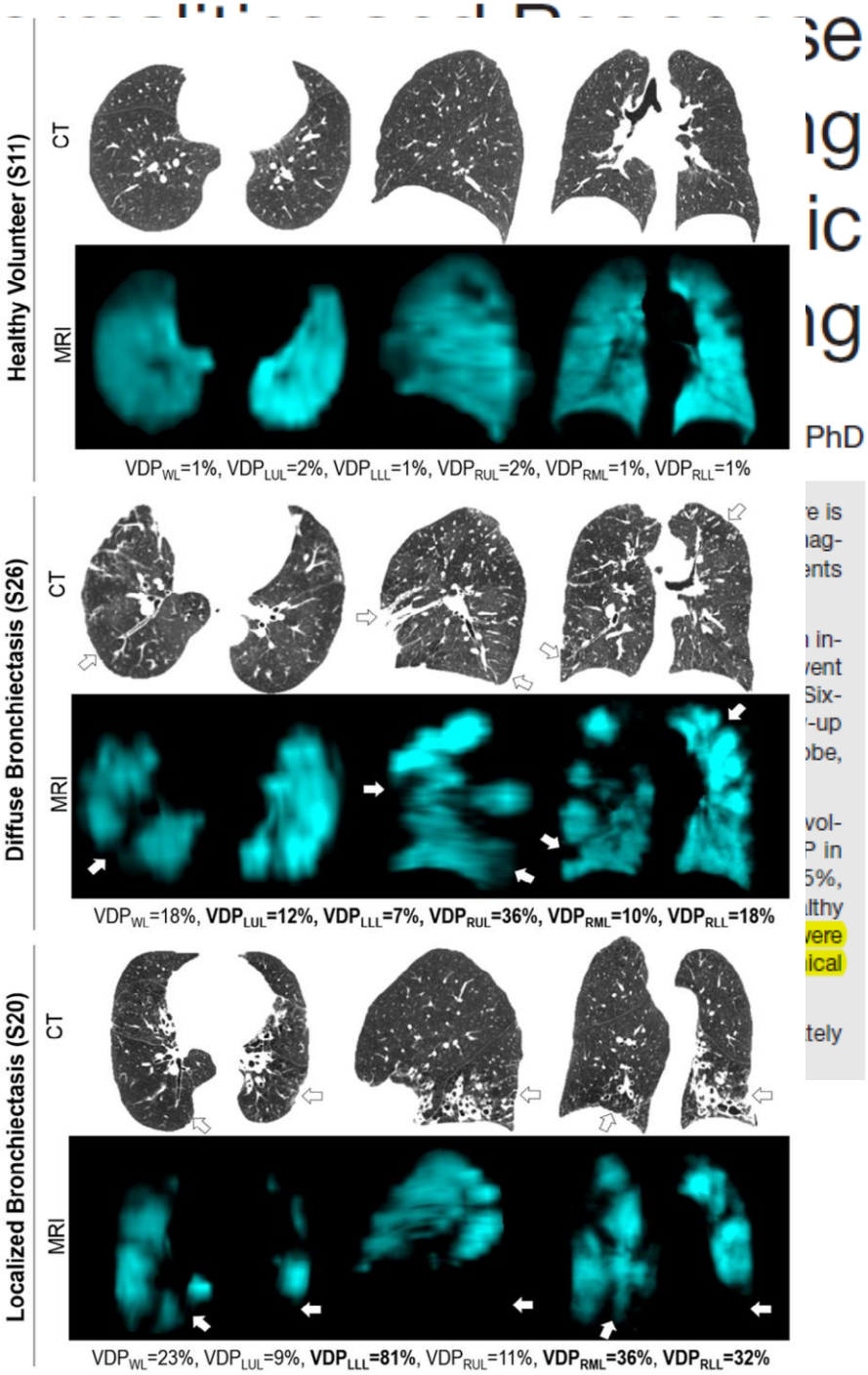
Sarah Svenningsen, PhD, Fumin Guo, …PhD

**Rationale and Objectives:** Evidence-based treat…e is a need for regional disease measurements as foca…ag- netic resonance imaging (MRI) to detect regional …ents with noncystic fibrosis (CF) bronchiectasis, provid…

**Materials and Methods:** Fifteen participants with…in- formed consent to an ethics board-approved Hea…vent spirometry, plethysmography, computed tomograp…Six- Minute Walk Test, the St. George's Respiratory qu…-up visit after 3 weeks of daily oscillatory positive expir…obe, and MRI ventilation defect percent (VDP) was me…

**Results:** CT evidence of bronchiectasis and abno…vol- unteers. There was CT evidence of bronchiectasi…P in lobes with CT evidence of bronchiectasis (19 ± 12%…5%, $P = .001$). For patients, VDP in lung lobes with ($P <$ …lthy volunteers (3 ± 1%). For all patients, mean PEQ-ea…were significantly improved post-oscillatory positive exp…ical important difference was observed for 8 of the 14…

**Conclusions:** There was CT and MRI evidence …tely half, there was evidence of ventilation improveme…

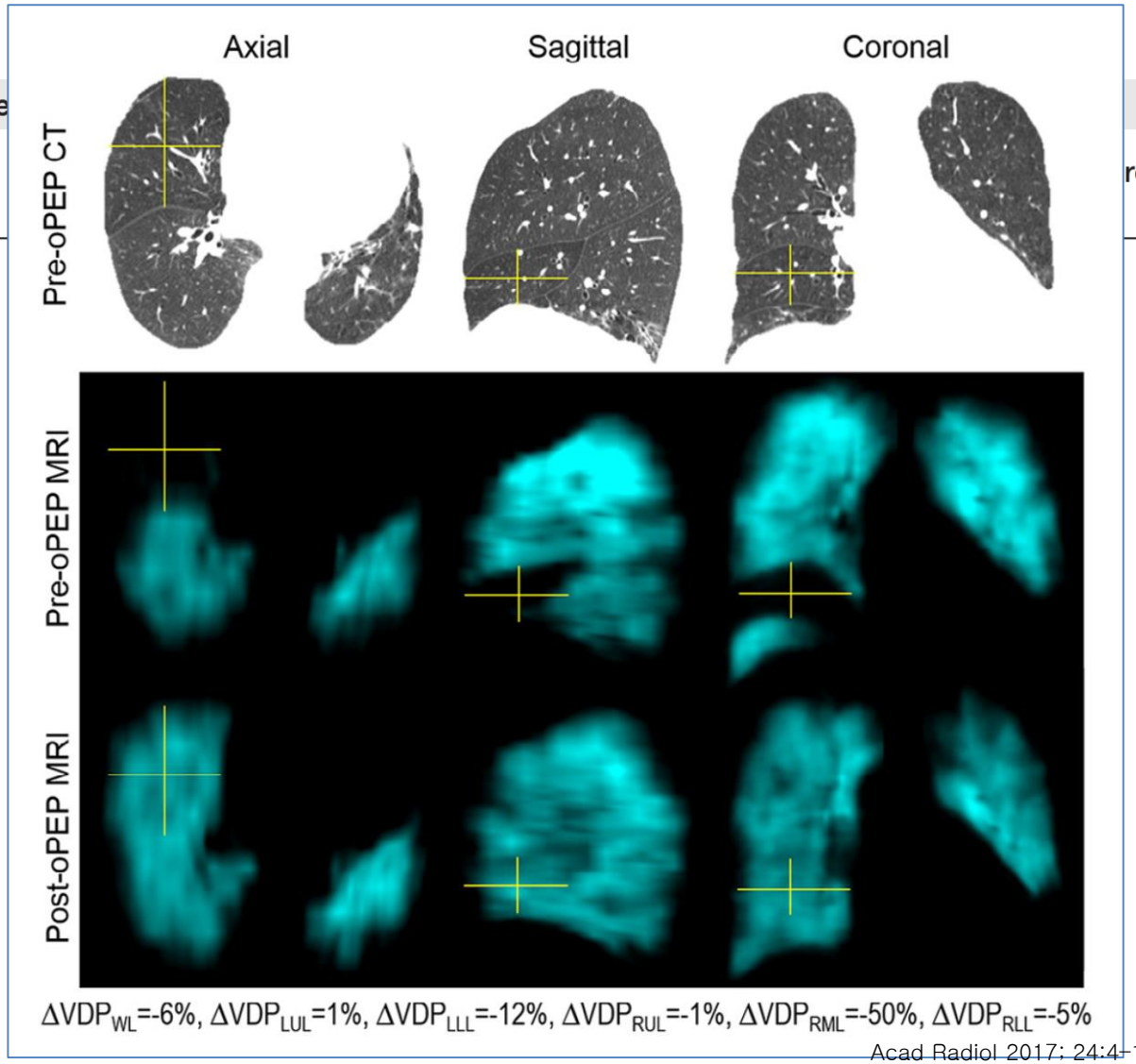



Acad Radiol 2017; 24:4–12

# Regional Abnormalities and Response to Airway Clearance Therapy Using Pulmonary Functional MRI

**TABLE 2. Pre- and Post-oPEP Measureme**

| Parameter (±SD) | rence |
|---|---|
| $FEV_1$ $\%_{pred}$ | |
| FVC $\%_{pred}$ | |
| 6MWD m | |
| SGRQ Total Score | |
| **PEQ** | |
| Cough frequency | |
| Ease-Bringing-Up-Sputum | |
| Patient-Global-Assessment | |
| **MRI** | |
| $VDP_{WL}$ % | |
| $VDP_{LUL}$ % | |
| $VDP_{LLL}$ % | |
| $VDP_{RUL}$ % | |
| $VDP_{RML}$ % | |
| $VDP_{RLL}$ % | |




Acad Radiol 2017; 24:4-12

# Long-term benefits of airway clearance in bronchiectasis: a randomised placebo-controlled trial

Gerard Muñoz[1,2], Javier de Gracia[3,4,5], Maria Buxó[6], Antonio Alvarez[3,4] and Montserrat Vendrell[1,3]

**Affiliations**: [1]Dept of Pneumology, Dr Josep Trueta University Hospital, Bronchiectasis Group IDIBGI, Universitat de Girona, Girona, Spain. [2]Dept of Physical Therapy, EUSES, Girona, Spain. [3]Ciberes CB06/06/0030, Spain. [4]Dept of Pneumology, VHIR, Vall d'Hebron University Hospital, Barcelona, Spain. [5]Dept of Medicine, Universitat Autònoma Barcelona, Barcelona, Spain. [6]IDIBGI, Girona, Spain.

- **Aim: the efficacy of the ELTGOL (slow expiration with the glottis opened in the lateral posture) technique over a 1-year period in bronchiectasis**
- **12-month RCT**
  ELTGOL technique (n=22) or placebo exercises (n=22) twice daily (ClinicalTrials.gov, NCT01578681)
  ELTGOL vs. upper limb stretching exercise
  Twice daily for 15min in affected lung
- 1′ outcome: sputum volume during the first intervention and 24 h later

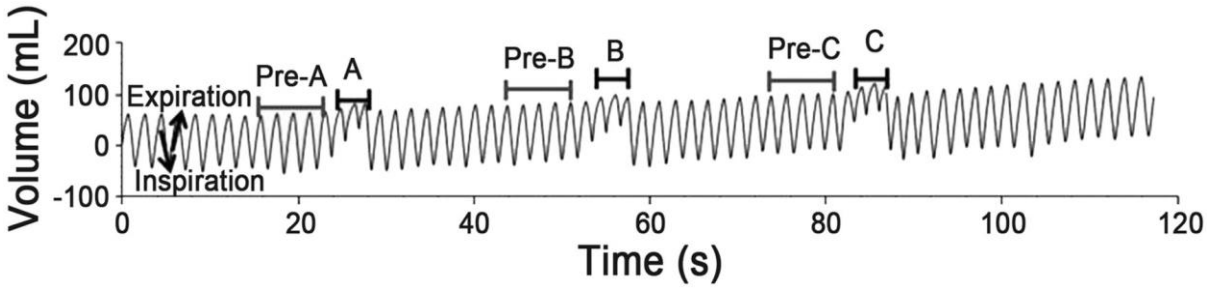
10.1183/13993003.01926-2017].

ABSTRACT Keeping airways clear of mucus by airway clearance techniques seems essential in bronchiectasis treatmen
have been conducted. V

**Muñoz G, de Gracia J, Buxó M,** et al**.** Eur Respir J **2018; 51: 1701926**

# Slow expiration with the glottis opened in a lateral posture or ELTGOL

(L'Expiration Lente Totale Glotte Ouverte en decubitus Latéral)



| | Sputum volume mL | | p-value |
|---|---|---|---|
| | ELTGOL group | Placebo group | |
| **Baseline 24-h** | 20 (15–40) | 15 (15–20) | 0.061 |
| **Visit 2 overall 24-h** | 40 (23.75–60) | 12.5 (0–20) | <0.001 |
| During intervention | 12.27±11.93 | 0 | |
| 24 h later | 30 (20–45) | 12.5 (0–20) | <0.001 |
| **Difference between visit 2 and baseline+** | 17.5 (10–26.25) | −5 (−11.25–0) | <0.001 |

| | ELTGOL | | | Placebo | |
|---|---|---|---|---|---|
| | Baseline | Month 12 | Between-group differences | Baseline | Month 12 |
| **SGRQ total score** | 40.2±13.7 | 33.7±15.7 | −6.8 (−15.1–1.5)+ | 35.0±9.9 | 47.6±12.8 |
| **LCQ total score** | 14.5±3.4 | 16.2±3.2 | 1.96 (0.2–3.8)+ | 15.7±2 | 13.7±2.1 |
| **Exacerbations** | 2 (1–3.25) | 1 (0–2) | −0.8 (−1.5– −0.1)¶ | 1(0.75–2.25) | 2 (1–3) |
| **FEV1% predicted** | 58.1±22.9 | 57.9±25 | −0.4 (−3.5–2.8)+ | 64.6±21.1 | 61.3±21 |
| **FEV1 L** | 1.6±0.8 | 1.6±0.8 | −0.004 (−0.1–0.03)+ | 1.5±0.4 | 1.5±0.4 |
| **mMRC** | 1 (0–1.25) | 1 (0–1) | 0 (−0.5–0)¶ | 1 (1–1.25) | 1 (1–2) |
| **6MWT m** | 417.8±67 | 423.5±84.9 | 2.3 (−16.7–21.2)+ | 382.9±76.9 | 377.8±57.3 |
| **ESR mm** | 22.3±26.5 | 17.1±17.5 | 9 (7–23)+ | 25.5±22.3 | 23.9±17.6 |
| **Leukocytes $\times 10^3\ \mu L^{-1}$** | 6.9±2 | 7.5±2 | 0.03 (−0.8–0.9)+ | 7.5±2.2 | 7.7±2.7 |
| **Neutrophils %** | 59.7±8.7 | 60±8.9 | −1.6 (−6.6–3.3)+ | 58.5±8.4 | 57.9±12.1 |
| **CRP $mg \cdot dL^{-1}$** | 0.7±0.9 | 1.7±2.7 | 0.7 (−0.7–2.2)+ | 0.6±0.5 | 0.7±0.6 |
| **Fibrinogen $mg \cdot dL^{-1}$** | 425.5±69 | 468.6±1000.5 | 43.9 (−31.3–119)+ | 449.6±930.5 | 492.6±125.2 |

| | | | |
|---|---|---|---|
| Oral antibiotic | 4 (18) | 2 (9) | |
| **Oral corticosteroid therapy#** | 1 (4.5) | 2 (9.1) | 1 |
| **Inhaled corticosteroid therapy** | 16 (72.7) | 17 (77.3) | 0.728 |
| **Inhaled bronchodilator therapy** | 16 (72.7) | 18 (81.8) | 0.360 |

# Airway clearance techniques for COPD

Cochrane Database of Systematic Reviews 2012

ACT
- included 'conventional' techniques, breathing exercises, and PEP or mechanical devices
- excluded suctioning and breathing strategies for purposes of relaxation (e.g. relaxed controlled breathing) or respiratory muscle strengthening (e.g. inspiratory/expiratory muscle training)

**ACTs for individuals with an AECOPD**

**Patient or population:** individuals with an exacerbation of COPD
**Settings:** hospital (inpatient ward or emergency department)
**Intervention:** airway clearance techniques (ACTs)

| Outcomes | Illustrative comparative risks* (95% CI) | | Relative effect (95% CI) | No of participants (studies) | Quality of the evidence (GRADE) | Comments |
|---|---|---|---|---|---|---|
| | Assumed risk | Corresponding risk | | | | |
| | Control | ACTs | | | | |
| Need for increased ventilatory assistance (invasive or non-invasive) | Study population | | OR 0.21 (0.05 to 0.85) | 171 (4 studies) | ⊕⊕◯◯ low[1,2] | |
| | 112 per 1000 | 26 per 1000 (6 to 97) | | | | |
| | Medium-risk population | | | | | |
| | 67 per 1000 | 15 per 1000 (4 to 58) | | | | |
| Duration of ventilatory assistance days | 7 days[3] | The mean duration of ventilatory assistance in the intervention groups was **2.05 lower** (2.6 to 1.51 lower) | | 54 (2 studies) | ⊕⊕◯◯ low[1,2] | |
| Length of hospital stay days | 9 days[3] | The mean length of hospital stay in the intervention groups was **0.75 lower** (1.38 to 0.11 lower) | | 171 (3 studies) | ⊕⊕◯◯ low[1,2] | |

# Airway clearance techniques for COPD [ in AECOPD]

**Figure 4. Forest plot of comparison: 1 Acute COPD: ACTs vs no ACTs (control), outcome: 1.5 Need for increased ventilatory assistance (invasive or non-invasive).**

| Study or Subgroup | ACTs Events | ACTs Total | Control Events | Control Total | Weight | Odds Ratio M-H, Fixed, 95% CI |
|---|---|---|---|---|---|---|
| **1.5.1 PEP techniques** | | | | | | |
| Bellone 2002 | 0 | 13 | 1 | 14 | 13.1% | 0.33 [0.01, 8.93] |
| Vargas 2005 | 0 | 16 | 6 | 17 | 57.5% | 0.05 [0.00, 1.05] |
| **Subtotal (95% CI)** | | **29** | | **31** | **70.5%** | **0.11 [0.01, 0.87]** |
| Total events | | | | | | |
| Heterogeneity: Chi² = 0.6 | | | | | | |
| Test for overall effect: Z = | | | | | | |
| **1.5.2 Non-PEP techniqu** | | | | | | |
| Inal-Ince 2004 | | | | | | |
| Newton 1978 | | | | | | |
| **Subtotal (95% CI)** | | | | | | |
| Total events | | | | | | |
| Heterogeneity: Chi² = 0.0 | | | | | | |
| Test for overall effect: Z = | | | | | | |
| **Total (95% CI)** | | | | | | |
| Total events | | | | | | |
| Heterogeneity: Chi² = 1.5 | | | | | | |
| Test for overall effect: Z = | | | | | | |
| Test for subgroup differe | | | | | | |

Odds Ratio M-H, Fixed, 95% CI

**Figure 5. Forest plot of comparison: 1 Acute COPD: ACTs vs no ACTs (control), outcome: 1.6 Duration of ventilatory assistance (days).**

Study
1.6.1
Bello
Subto
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Test f
1.6.2
Inal-I
Subto
Heter
Test f
Total
Heter
Test f
Test f

**Figure 6. Forest plot of comparison: 1 Acute COPD: ACTs vs no ACTs (control), outcome: 1.8 Length of hospital stay (days).**

| Study or Subgroup | ACTs Mean | ACTs SD | ACTs Total | Control Mean | Control SD | Control Total | Weight | Mean Difference IV, Fixed, 95% CI |
|---|---|---|---|---|---|---|---|---|
| **1.8.1 PEP techniques** | | | | | | | | |
| Vargas 2005 | 6.8 | 1 | 16 | 7.9 | 1.3 | 17 | 65.1% | -1.10 [-1.89, -0.31] |
| **Subtotal (95% CI)** | | | **16** | | | **17** | **65.1%** | **-1.10 [-1.89, -0.31]** |
| Heterogeneity: Not applicable | | | | | | | | |
| Test for overall effect: Z = 2.73 (P = 0.006) | | | | | | | | |
| **1.8.2 Non-PEP techniques** | | | | | | | | |
| Kodric 2009 | 9.5 | 3.2 | 30 | 10 | 2.4 | 29 | 19.5% | -0.50 [-1.94, 0.94] |
| Newton 1978 | 9.37 | 4.47 | 40 | 8.94 | 2.68 | 39 | 15.4% | 0.43 [-1.19, 2.05] |
| **Subtotal (95% CI)** | | | **70** | | | **68** | **34.9%** | **-0.09 [-1.17, 0.99]** |
| Heterogeneity: Chi² = 0.71, df = 1 (P = 0.40); I² = 0% | | | | | | | | |
| Test for overall effect: Z = 0.16 (P = 0.87) | | | | | | | | |
| **Total (95% CI)** | | | **86** | | | **85** | **100.0%** | **-0.75 [-1.38, -0.11]** |
| Heterogeneity: Chi² = 2.91, df = 2 (P = 0.23); I² = 31% | | | | | | | | |
| Test for overall effect: Z = 2.30 (P = 0.02) | | | | | | | | |
| Test for subgroup differences: Chi² = 2.20, df = 1 (P = 0.14), I² = 54.6% | | | | | | | | |

Mean Difference IV, Fixed, 95% CI

-2 -1 0 1 2

Favours experimental Favours control

Cochrane Database of Systematic Reviews 2012,

# Airway clearance techniques for COPD [ in stable COPD]

In people with stable COPD,
data from single studies revealed no significant short-term benefit of ACTs on the number of people with exacerbations (OR 3.21, 95% CI 0.12 to 85.20; one study on 30 people), significant short-term improvements in HRQoL as measured by the SGRQ total score (MD −6.10, 95% CI −8.93 to −3.27; one study on 15 people) and a reduced long-term need for respiratoryrelated hospitalisation (OR 0.27, 95% CI 0.08 to 0.95; one study on 35 participants)

In conclusion airway clearance techniques are safe for individuals with COPD and confer small beneficial effects on some clinical outcomes.

Consideration may be given to the use of airway clearance techniques for patients with COPD in both acute and stable disease, however current studies suggest that the benefits achieved may be small.

Cochrane Database of Systematic Reviews 2012, Issue 3.

COPD JOURNAL OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE

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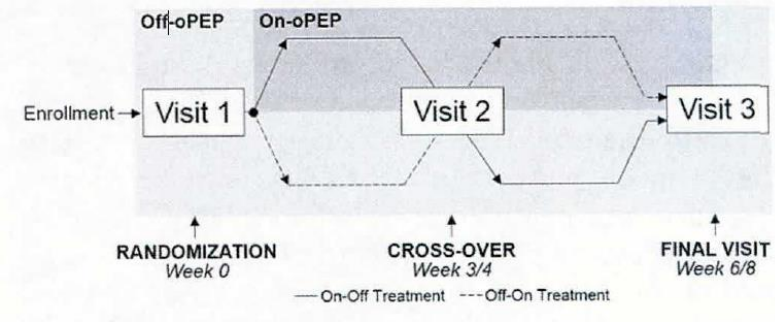
**ORIGINAL RESEARCH**

# Oscillatory Positive Expiratory Pressure in Chronic Obstructive Pulmonary Disease

Sarah Svenningsen,[1,2] Gregory A. Paulin,[1,2] Khadija Sheikh,[1,2] Fumin Guo,[1,3] Aasim Hasany,[1] Miranda Kirby,[1,2] Roya Etemad-Rezai,[4] David G. McCormack,[5] and Grace Parraga[1,2,3,4]



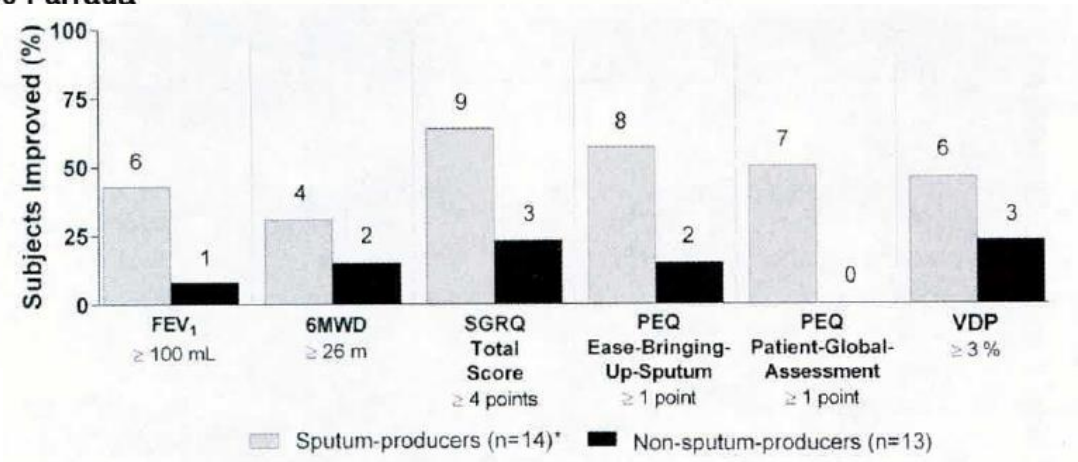
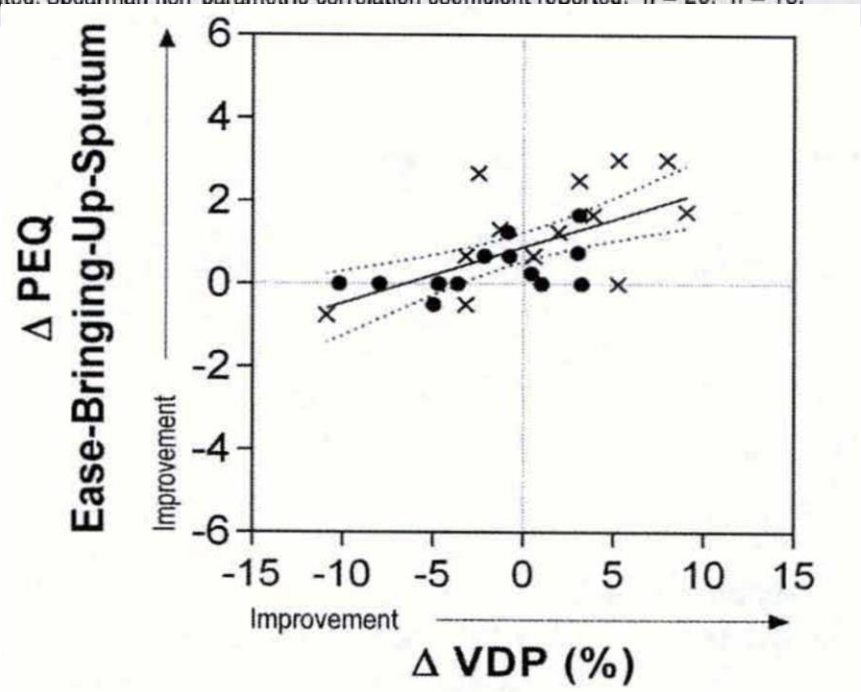




**Figure 3.** Clinically relevant post-oPEP improvements. Values = n improved ≥ minimum-clinically important-difference ($FEV_1$, 6MWD, SGRQ Total Score), smallest detectable difference (VDP) or 1-point score improvement (PEQ). $FEV_1$, forced expiratory volume in 1 second; 6MWD, 6-minute walk distance; SGRQ, St. George's Respiratory Questionnaire total score; PEQ, Patient Evaluation Questionnaire; VDP, ventilation defect percent; * n = 13 for 6MWD and VDP.

**Table 3.** Correlations for post-oPEP changes in PEQ Ease-Bringing-Up-Sputum and PEQ Patient-Global-Assessment

| | Pearson or Spearman correlation coefficients r/ρ (p) | | | | | |
|---|---|---|---|---|---|---|
| | Δ PEQ Ease-Bringing-Up-Sputum | | | Δ PEQ Patient-Global-Assessment | | |
| Parameter | All* (n = 27) | SP (n = 14) | NSP (n = 13) | All* (n = 27) | SP (n = 14) | NSP (n = 13) |
| $FEV_1$ $\%_{pred}$ | −0.06 (0.78) | −0.03 (0.91) | −0.13 (0.68) | 0.15 (0.44) | 0.08 (0.78) | 0.28 (0.37) |
| SGRQ Total Score | 0.13 (0.52) | 0.04 (0.90) | 0.04 (0.90) | 0.09 (0.67) | −0.10 (0.73) | −0.11 (0.15) |
| VDP % | 0.38 (0.05)# | 0.75 (0.003)† | 0.04 (0.89) | 0.28 (0.17)# | 0.66 (0.01)† | −0.24 (0.45) |

SP, sputum-producers; NSP, non-sputum-producers; $FEV_1$, forced expiratory volume in 1 second; $\%_{pred}$, percent predicted; SGRQ, St. George's Respiratory Questionnaire; VDP, ventilation defect percent; *Data are not normally distributed. Spearman non-parametric correlation coefficient reported: #n = 26; †n = 13.




- Non-sputum-producers

**PEQ Ease-Bringing-Up-Sputum**
**(r = 0.65, r2 = 0.39, p = 0.0004)**

# In small studies with COPD patients, an Oscillating PEP device

- Reduces exacerbations by 28% in the critical 30-day period
- Is a cost-effective addition to disease management
- Improves quality of life
- Improves lung function
- Improves ventilation
- Proprietary wave form delivers efficient and effective results

-Total Pressure Pulse Index

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2017 Chest
http://www.touchrespiratory.com/gallery/why-opep-devices-are-not-same

BMJ Open Respiratory Research

# Adjuncts for sputum clearance in COPD: clinical consensus versus actual use

Ruth Barker,[1] Anthony A Laverty,[2] Nicholas S Hopkinson[1]

**Table 1** UK prescribing data for sputum clearance medications and devices

| Year | Carbocisteine (treatment years) | Carbocisteine cost | Tiotropium (treatment years) | Tiotropium cost | OPEP device (n) | OPEP device cost |
|---|---|---|---|---|---|---|
| 2013 | 102 203 | £18 731 563 | 295 691 | £129 183 487 | 976 | £36 570 |
| 2014 | 152 242 | £25 929 656 | 403 363 | £175 912 591 | 1836 | £68 791 |
| 2015 | 168 299 | £28 316 401 | 409 224 | £178 550 070 | 2177 | £81 509 |
| Total | 422 744 | £72 977 620 | 1 108 278 | £483 646 148 | 4989 | £1 86 870 |

Data from OpenPrescribing.net, EBM DataLab, University of Oxford, 2017 (https://openprescribing.net/).
Treatment year was calculated by dividing number of items prescribed per year by 12. For carbocisteine, paediatric preparations were excluded.
OPEP, oscillatory positive expiratory pressure.

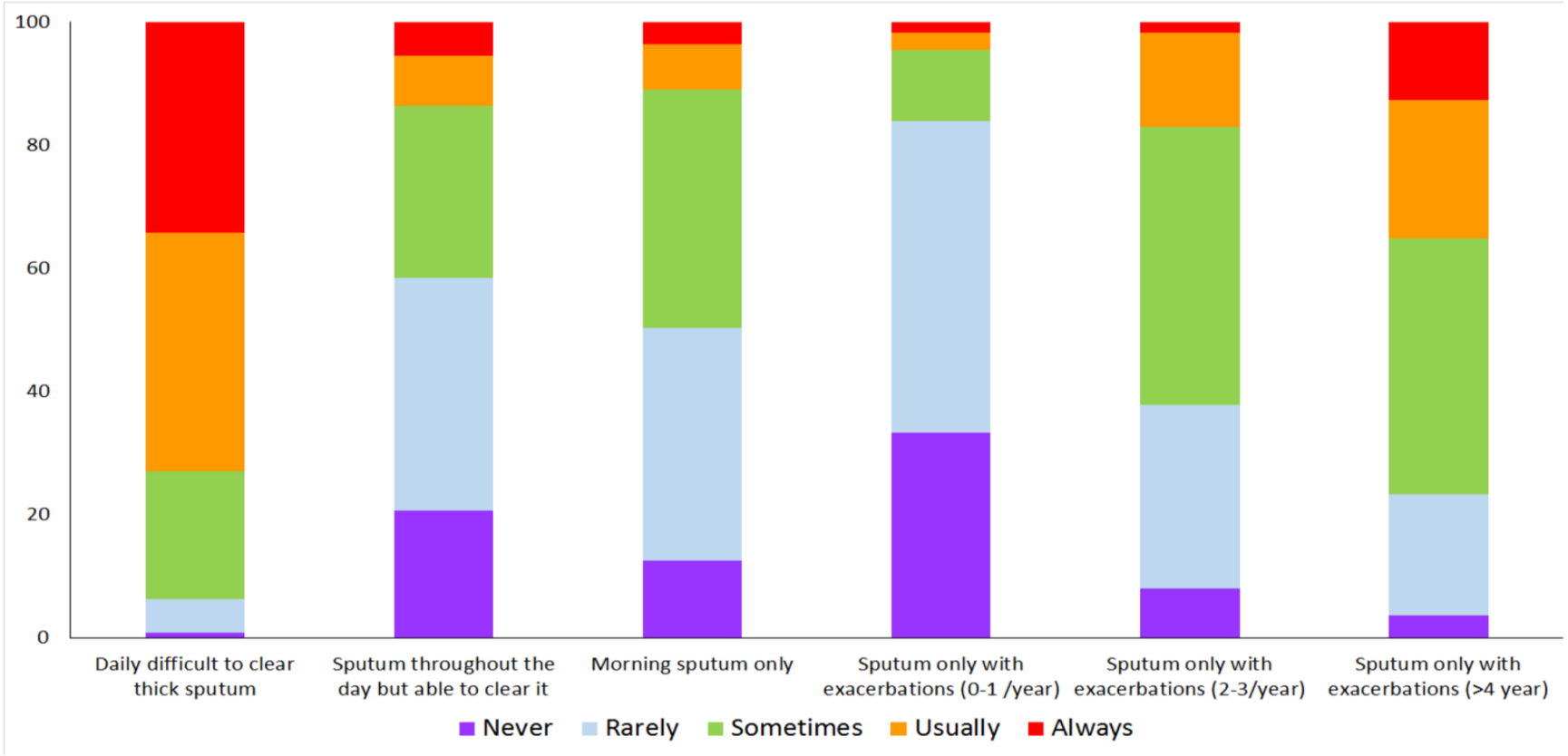



**Figure 1** How often would responders recommend oscillatory positive pressure devices for sputum clearance in a patient with this chronic obstructive pulmonary disease phenotype?

**Table 3** Reported frequency of use of sputum adjunct devices for patients with COPD in the preceding year

| | No of patients treated with device | | | |
|---|---|---|---|---|
| | **None** | **1–2** | **3–5** | **>5** |
| Flutter | 59.5% | 18.0% | 8.1% | 14.4% |
| Acapella | 47.8% | 22.5% | 8.1% | 21.6% |
| PEP mask | 79.3% | 15.3% | 3.6% | 1.8% |

# Which technique is preferred?

# Chest physiotherapy

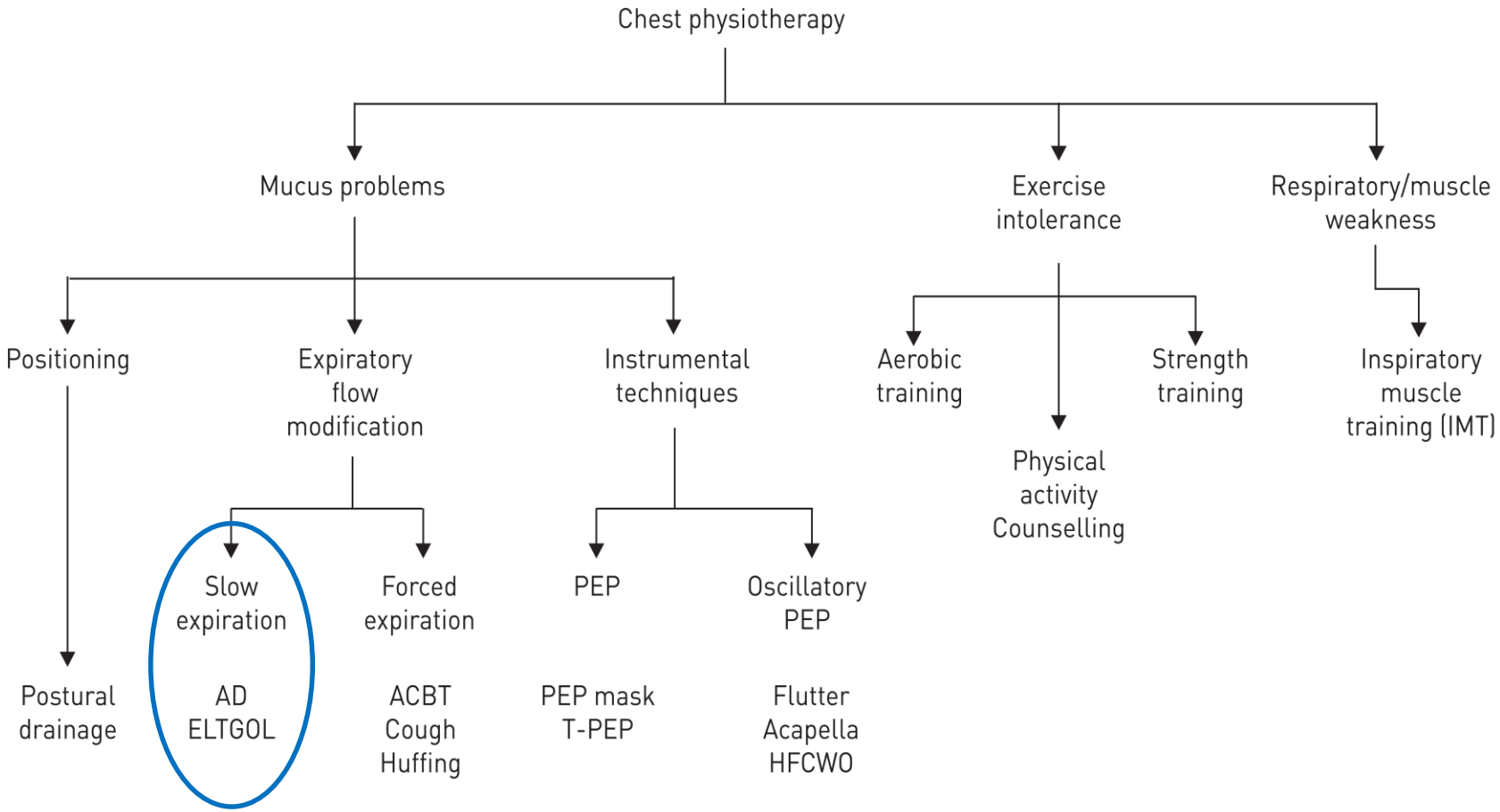


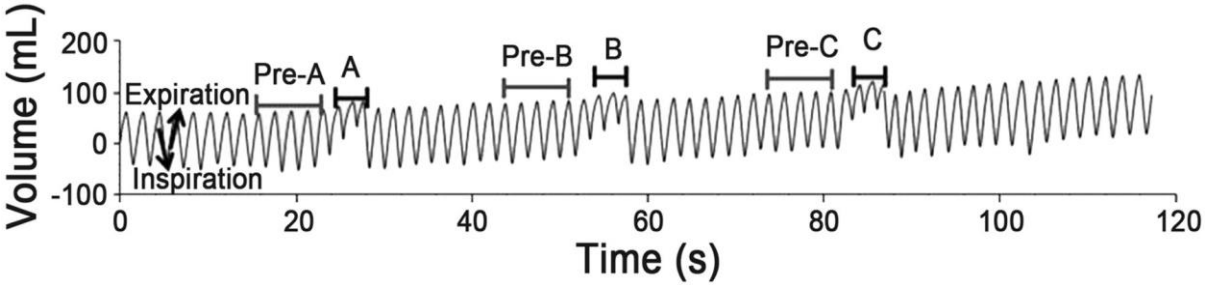

FIGURE 6 Chest physiotherapy interventions flow chart based on clinical experience from the task force panel. AD: autogenic drainage; ELTGOL: total slow expiration with open glottis and infralateral position; ACBT: active cycle of breathing techniques; PEP: positive expiratory pressure; T-PEP: temporary positive expiratory pressure; HFCWO: high frequency chest wall oscillation.

Eur Respir J 2017; 50: 1700629

# Slow expiration with the glottis opened in a lateral posture or ELTGOL

(L'Expiration Lente Totale Glotte Ouverte en decubitus Latéral)

- The goal is to control expiratory flow to prevent airway closure and facilitate mucus clearance
- Mucus clearance is only increased in the dependent, inferiorly positioned lung



# Long-term benefits of airway clearance in bronchiectasis: a randomised placebo-controlled trial

Gerard Muñoz[1,2], Javier de Gracia[3,4,5], Maria Buxó[6], Antonio Alvarez[3,4] and Montserrat Vendrell[1,3]

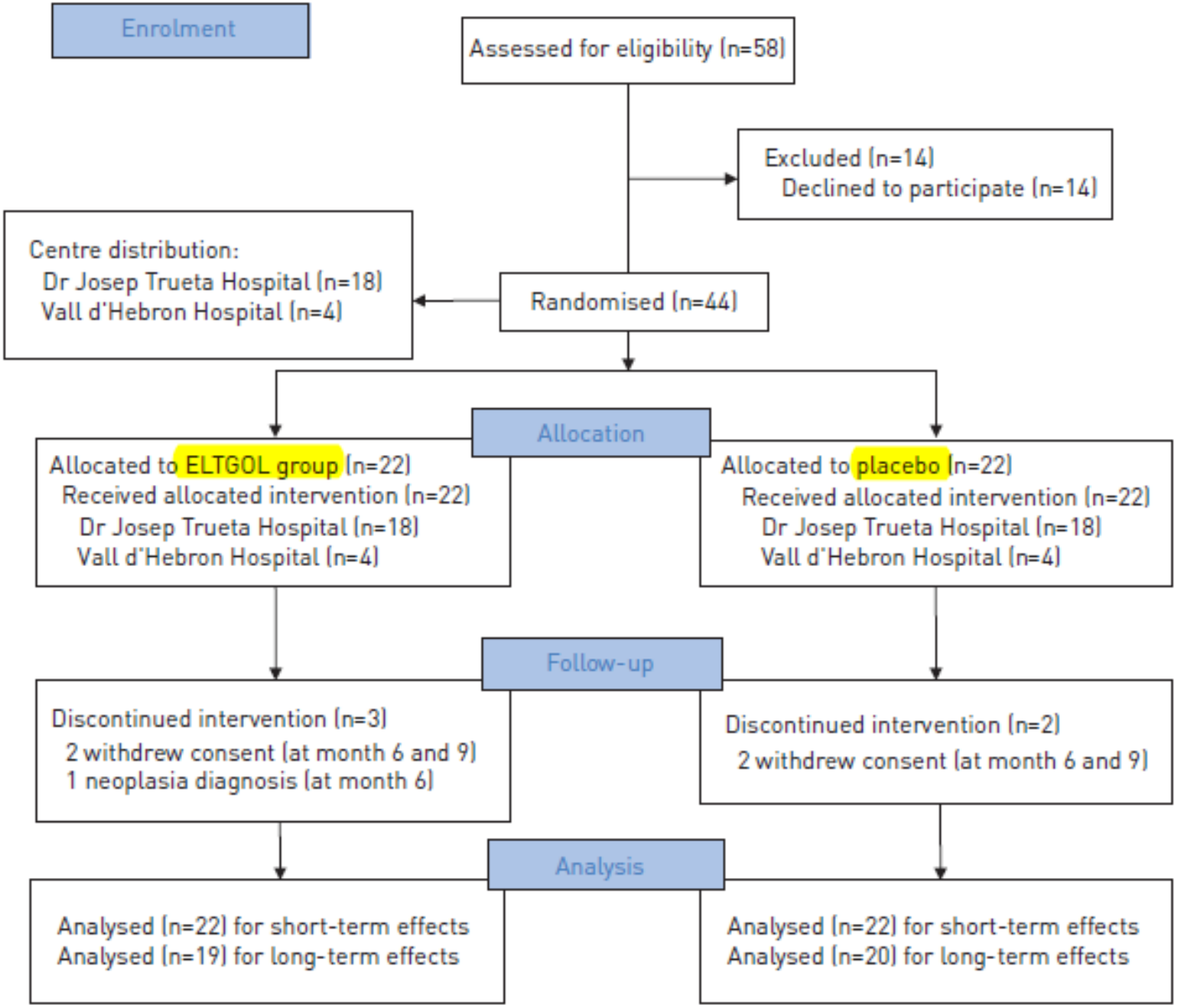
**Affiliations**: [1]Dept of Pneumology, Dr Josep Trueta University Hospital, Bronchiectasis Group IDIBGI, Universitat de Girona, Girona, Spain. [2]Dept of Physical Therapy, EUSES, Girona, Spain. [3]Ciberes CB06/06/0030, Spain. [4]Dept of Pneumology, VHIR, Vall d'Hebron University Hospital, Barcelona, Spain. [5]Dept of Medicine, Universitat Autònoma Barcelona, Barcelona, Spain. [6]IDIBGI, Girona, Spain.

- **Aim: the efficacy of the ELTGOL (slow expiration with the glottis opened in the lateral posture) technique over a 1-year period in bronchiectasis**
- **12-month RCT**
  ELTGOL technique (n=22) or placebo exercises (n=22) twice daily (ClinicalTrials.gov, NCT01578681)
  ELTGOL vs. upper limb stretching exercise
  Twice daily for 15min in affected lung
- 1′ outcome: sputum volume during the first intervention and 24 h later

10.1183/13993003.01926-2017].

ABSTRACT Keeping airways clear of mucus by airway clearance techniques seems essential in bronchiectasis treatmen
have been conducted. V

**Muñoz G, de Gracia J, Buxó M,** et al**.** Eur Respir J **2018; 51: 1701926**


Enrolment
Assessed for eligibility (n=58)
Excluded (n=14)
Declined to participate (n=14)
Centre distribution:
Dr Josep Trueta Hospital (n=18)
Vall d'Hebron Hospital (n=4)
Randomised (n=44)
Allocation
Allocated to ELTGOL group (n=22)
Received allocated intervention (n=22)
Dr Josep Trueta Hospital (n=18)
Vall d'Hebron Hospital (n=4)
Allocated to placebo (n=22)
Received allocated intervention (n=22)
Dr Josep Trueta Hospital (n=18)
Vall d'Hebron Hospital (n=4)
Follow-up
Discontinued intervention (n=3)
2 withdrew consent (at month 6 and 9)
1 neoplasia diagnosis (at month 6)
Discontinued intervention (n=2)
2 withdrew consent (at month 6 and 9)
Analysis
Analysed (n=22) for short-term effects
Analysed (n=19) for long-term effects
Analysed (n=22) for short-term effects
Analysed (n=20) for long-term effects

| | Sputum volume mL | | p-value |
|---|---|---|---|
| | ELTGOL group | Placebo group | |
| **Baseline 24-h** | 20 (15–40) | 15 (15–20) | 0.061 |
| **Visit 2 overall 24-h** | 40 (23.75–60) | 12.5 (0–20) | <0.001 |
| During intervention | 12.27±11.93 | 0 | |
| 24 h later | 30 (20–45) | 12.5 (0–20) | <0.001 |
| **Difference between visit 2 and baseline+** | 17.5 (10–26.25) | −5 (−11.25–0) | <0.001 |
| **Month 12 overall 24-h** | 35 (30–50) | 15 (10–20) | <0.001 |

| | ELTGOL | | | Placebo | |
|---|---|---|---|---|---|
| | Baseline | Month 12 | Between-group differences | Baseline | Month 12 |
| **SGRQ total score** | 40.2±13.7 | 33.7±15.7 | −6.8 (−15.1–1.5)+ | 35.0±9.9 | 47.6±12.8 |
| **LCQ total score** | 14.5±3.4 | 16.2±3.2 | 1.96 (0.2–3.8)+ | 15.7±2 | 13.7±2.1 |
| **Exacerbations** | 2 (1–3.25) | 1 (0–2) | −0.8 (−1.5– −0.1)¶ | 1(0.75–2.25) | 2 (1–3) |
| **FEV1% predicted** | 58.1±22.9 | 57.9±25 | −0.4 (−3.5–2.8)+ | 64.6±21.1 | 61.3±21 |
| **FEV1 L** | 1.6±0.8 | 1.6±0.8 | −0.004 (−0.1–0.03)+ | 1.5±0.4 | 1.5±0.4 |
| **mMRC** | 1 (0–1.25) | 1 (0–1) | 0 (−0.5–0)¶ | 1 (1–1.25) | 1 (1–2) |
| **6MWT m** | 417.8±67 | 423.5±84.9 | 2.3 (−16.7–21.2)+ | 382.9±76.9 | 377.8±57.3 |
| **ESR mm** | 22.3±26.5 | 17.1±17.5 | 9 (7–23)+ | 25.5±22.3 | 23.9±17.6 |
| **Leukocytes ×10$^3$ µL$^{-1}$** | 6.9±2 | 7.5±2 | 0.03 (−0.8–0.9)+ | 7.5±2.2 | 7.7±2.7 |
| **Neutrophils %** | 59.7±8.7 | 60±8.9 | −1.6 (−6.6–3.3)+ | 58.5±8.4 | 57.9±12.1 |
| **CRP mg·dL$^{-1}$** | 0.7±0.9 | 1.7±2.7 | 0.7 (−0.7–2.2)+ | 0.6±0.5 | 0.7±0.6 |
| **Fibrinogen mg·dL$^{-1}$** | 425.5±69 | 468.6±1000.5 | 43.9 (−31.3–119)+ | 449.6±930.5 | 492.6±125.2 |

| | | | |
|---|---|---|---|
| Inhaled corticosteroid therapy | 16 (72.7) | 17 (77.3) | 0.728 |
| Inhaled bronchodilator therapy | 16 (72.7) | 18 (81.8) | 0.360 |

ELSEVIER

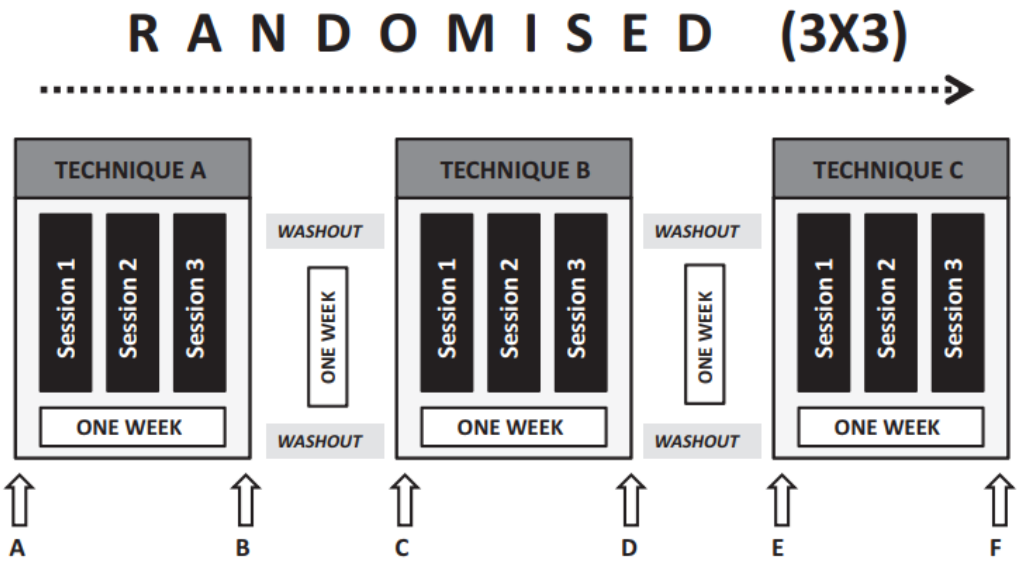
Physiotherapy

Physiotherapy 102 (2016) 357–364

# Short-term effects of three slow expiratory airway clearance techniques in patients with bronchiectasis: a randomised crossover trial

B. Herrero-Cortina [a,b], J. Vilaró [c], D. Martí [a,*], A. Torres [a,d], M. San Miguel-Pagola [b], V. Alcaraz [a], E. Polverino [a]






- Autogenic drainage (AD)
- Slow expiration with glottis opened in lateral posture (ELTGOL)
- Temporary positive expiratory pressure (TPEP)

Fig. 1. Study design. Autogenic drainage (AD), slow expiration with glottis opened in lateral posture (ELTGOL) and temporary positive expiratory pressure (TPEP) were the airway clearance techniques (ACTs) performed in a randomised order. Global health outcomes (cough severity and pulmonary function test) were performed at the start and end of each treatment arm (arrows).

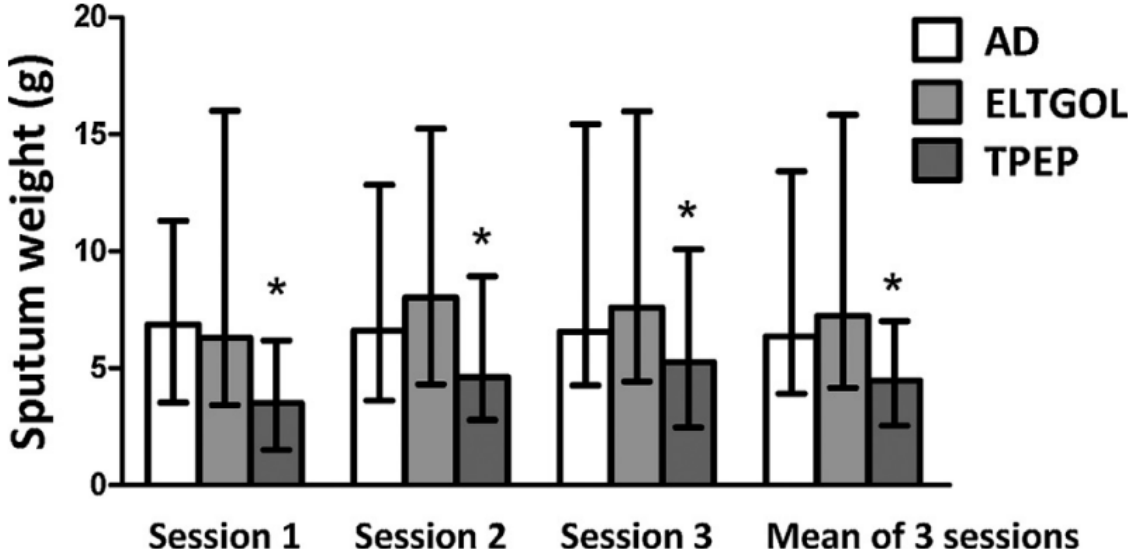



Table 2

Change in Leicester Cough Questionnaire score after 1 week of treatment for each slow expiratory airway clearance technique.

| | Total score | | | Physical score | | | Psychological score | | | Social score | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Median difference | 95% CI | *P*-value | Median difference | 95% CI | *P*-value | Median difference | 95% | *P*-value | Median difference | 95% CI | *P*-value |
| AD | 0.5 | 0.1 to 0.5 | 0.01 | 0.1 | 0.0 to 0.3 | 0.1 | 0.1 | −0.1 to 0.4 | 0.1 | 0.0 | −0.1 to 0.5 | 0.2 |
| ELTGOL | 0.9 | 0.5 to 2.1 | 0.001 | 0.4 | −0.1 to 0.6 | 0.006 | 0.3 | 0.1 to 0.6 | 0.001 | 0.2 | 0.1 to 0.9 | 0.001 |
| TPEP | 0.4 | 0.1 to 1.2 | 0.04 | 0.1 | −0.1 to 0.3 | 0.3 | 0.1 | 0.0 to 0.5 | 0.06 | 0.1 | 0.0 to 0.5 | 0.02 |

AD, autogenic drainage; ELTGOL, slow expiration with glottis opened in lateral posture; TPEP, temporary positive expiratory pressure; CI, confidence interval.
Wilcoxon's tests were performed. $P < 0.05$ was considered to indicate statistical significance.

Respiratory Medicine (2012) 106, 155–172

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REVIEW

# The active cycle of breathing technique: A systematic review and meta-analysis

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KEYWORDS
Breathing exercises;
Bronchiectasis;
Cystic fibrosis;
Meta-analysis;
Physical therapy techniques;
Review systematic

Summary
*Question:* What is the best available research evidence (volume, quality, consistency, generalisability) for the active cycle of breathing technique (ACBT)?
*Design:* Systematic review with meta-analysis.
*Participants:* Participants with respiratory conditions characterised by chronic sputum production.
*Intervention:* The active cycle of breathing or forced expiratory technique.
*Comparator:* All comparators including control conditions.
*Outcome measures:* All outcomes providing continuous data.
*Results:* Twenty-four studies were included. Ten comparators were identified with the most common being conventional chest physiotherapy, positive expiratory pressure and a control. The outcomes most frequently assessed were sputum wet weight ($n = 17$), forced vital capacity ($n = 12$) and forced expiratory volume in 1 s ($n = 12$). Meta-analysis was completed on the primary outcome of sputum wet weight. The standardised mean difference (SMD, random effects) showed an increase in sputum wet weight during and up to 1 h post ACBT compared to conventional physiotherapy (SMD 0.32, 95%CI 0.05–0.59), external oscillatory devices (0.75, 0.48–1.02), and control (0.24, 0.02–0.46).
*Conclusion:* The overall body of evidence was classified as good (good volume, quality and consistency, excellent generalisability). High level, variable risk of bias research evidence favours ACBT over most alternatives for short-term improvements in secretion clearance.

# The techniques of FET/ACBT were shown to have a more beneficial short-term effect on sputum wet weight when compared to CPT, external oscillatory devices and a control

There was no clear evidence of a beneficial short term effect on sputum wet weight when compared to RIM and PEP, or in the 24 h post-treatment when compared to CPT, oral devices or a control.

**Table 6** Sputum wet weight effect estimates per comparator.

| Comparator | Sputum weight collection time | Studies (*n*) | Participants (*n*) | Overall effect estimate SMD (95%CI) | Heterogeneity |
|---|---|---|---|---|---|
| RIM | During – 30 min | 2 | 40 | −1.08 (−3.85 to 1.70) | $p < 0.00001$ |
| CPT | During – 30 min | 1 | 16 | 0.32 (0.05 to 0.59) | N/A |
| | 24 h | 1 | 8 | 0.07 (−0.30 to 0.44) | N/A |
| PEP | During – 30 min | 2 | 46 | 0.26 (−0.11 to 0.63) | $p = 0.04$ |
| Oral devices | During – 30 min | 2 | 56 | 0.33 (−0.04 to 0.71) | $p = 0.02$ |
| | 24 h | 2 | 15 | 0.16 (−0.38 to 0.70) | $p = 0.04$ |
| | 4 week | 1 | 17 | 0.04 (−0.21, 0.29) | N/A |
| External devices | During – 30 min | 1[a] | 10 | 0.75 (0.48 to 1.02) | $p = 0.40$ |
| Control | During – 30 min | 1 | 24 | 0.24 (0.02 to 0.46) | N/A |
| | 24 h | 1 | 8 | 0.38 (−0.01 to 0.77) | N/A |

CPT Conventional physiotherapy, N/A not applicable, PEP Positive expiratory pressure, RIM Resisted inspiratory manoeuvres, SMD Standardised mean difference Shaded cells denote significant overall effect ($p < 0.05$).

[a] Phillips et al., 2004 contained morning and evening data sets which were treated separately in the meta-analysis.

Respiratory Medicine (2012) 106, 155e

**Table 5** Summary of participant preference findings from the included studies.

| Study | *n* | Intervention/comparator | Participant preference/ acceptability |
|---|---|---|---|
| Eaton et al 2007[6] | 36 | ACBT + PD, ACBT, Flutter | 33% preferred ACBT + PD, 22% ACBT, 44% flutter |
| Falk et al 1984[29] | 14 | FET, CPT, PEP + PD, PEP (sitting) | 79% preferred PEP (sitting) |
| Patterson et al 2005[38] | 20 | ACBT, Acapella | A greater proportion of participants preferred acapella to ACBT but this was not significant (MD 0.4, 95%CI −0.04–0.71) |
| Phillips et al 2004[7] | 10 | ACBT, Hayek oscillator | All participants reported that |
| | | | completion of the study |
| Thompson et al 2002[39] | 17 | ACBT, Flutter | 65% preferred flutter versus ACBT for long term use |
| Milne & Eales 2004[35] | 7 | ACBT, Flutter | 43% preferred ACBT, 29% flutter, 29% no preference |
| Patterson et al 2004[40] | 20 | ACBT, RIM | 55% reported that ACBT was more effective, 20% RIM, 25% no preference. 50% preferred ACBT and 50% preferred RIM for home treatment |
| Miller et al 1995[37] | 18 | ACBT, AD | 44% preferred ACBT, 50% AD, 6% no preference |

AD Autogenic drainage, CPT Conventional physiotherapy, PEP Positive expiratory pressure, PD Postural drainage, RIM Resisted inspiratory

- The techniques of FET/ACBT were shown to have a more beneficial short-term effect on sputum wet weight when compared to CPT, external oscillatory devices and a control.
- There was limited evidence that the participants in the majority of studies preferred other treatment techniques to FET/ACBT.

# Positive Expiratory Pressure (PEP) therapy *vs.* other ACT in BE

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**Patient or population:** people with bronchiectasis
**Settings:** hospital inpatient and outpatient department, home-based therapy
**Intervention:** positive expiratory pressure (PEP) therapy
**Comparison:** other airway clearance techniques (ACTs)

| Outcomes | Illustrative comparative risks* (95% CI) | | Relative effect (95% CI) | No of Participants (studies) | Quality of the evidence (GRADE) | Comments |
|---|---|---|---|---|---|---|
| | Assumed risk | Corresponding risk | | | | |
| | Other airway clearance techniques (ACTs) | Positive expiratory pressure (PEP) therapy | | | | |
| **Cough-related quality of life (QOL)** assessed with: Leicester cough questionnaire total score. Higher score indicates better QOL. 19 questions on 7-point Likert scale | The median change in cough-related quality of life (QOL) was 0.5 points (95% CI 0.1 to 0.5) | The median change in cough-related quality of life (QOL) in the intervention group was 0.1 points lower | - | 31 participants (one study) | ⊕⊕◯◯ **low**[1,2] | Randomised cross-over trial of minimal PEP therapy vs Autogenic drainage. Duration of intervention of 1 week per ACT |
| **Health-related quality of life (HRQOL)** disease-specific HRQOL assessed with: Chronic respiratory disease questionnaire total score<br>Scale from: 0 to 28<br>follow-up: mean 4 weeks | not provided | not provided | The mean difference (95% CI) between groups was -0.09 points per item (-0.37 to 0.19) in favour of oscillatory PEP therapy | 17 participants (one study) | ⊕⊕◯◯ **low**[1,3] | Randomised cross-over trial of ACBT vs Oscillatory PEP therapy (Flutter). Duration of intervention of 4 weeks per ACT |

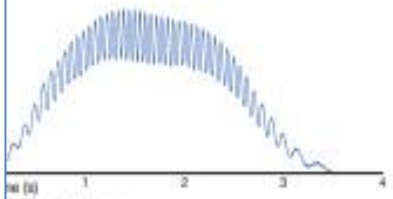
PEP therapy appears to have similar effects onHRQOL, symptoms of breathlessness, sputumexpectoration, and lung volumes compared to other ACTs when prescribed within a stable clinical state or during an acute exacerbation.

Cochrane Database of Systematic Reviews 2017, Issue 9. Art. No.:

Total Pressure Pulse Impact (TPPI)
= SUM of discernable pressure amplitudes in a single exhalation

# Table 1: Device Performance Comparison

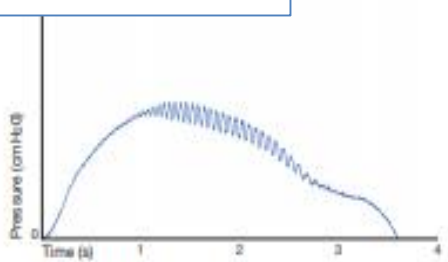
| Device | tosc [%] | Avg Amp [cm $H_2O$] | # of osc | TPPI [cm $H_2O$] |
|---|---|---|---|---|
| ***Aerobika**** Device | 81% | 13.9 | 36 | 495 |
| vibraPEP† | 69% | 9.4 | 27 | 256 |
| Acapella Choice† | 67% | 5.8 | 41 | 236 |
| Flutter† | 62% | 3.0 | 46 | 139 |
| vPEP† | 45% | 4.5 | 25 | 112 |

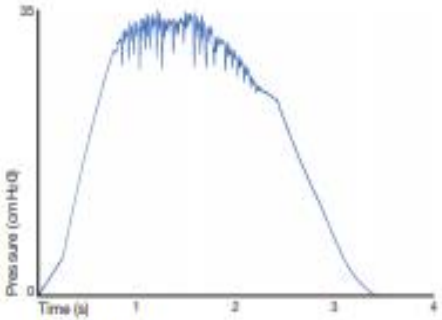




Acapella Choice†, *Smiths Medical, USA*


VibraPEP†, *Curaplex, USA*

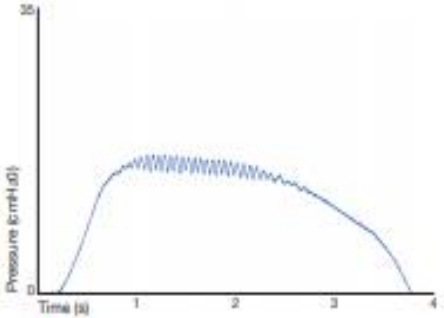


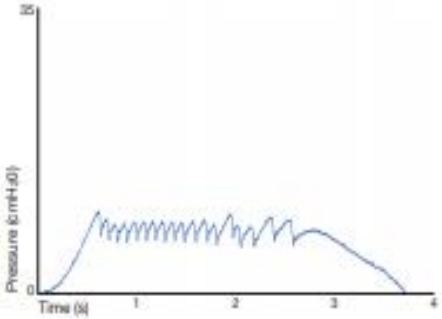





Flutter†, *Axcan, USA*


vPEP†, *D R Burton, USA*




- The pressure/time waveforms were recorded (Pressure Transducer, Honeywell, USA) for each device, set at their highest resistance to enable direct comparison

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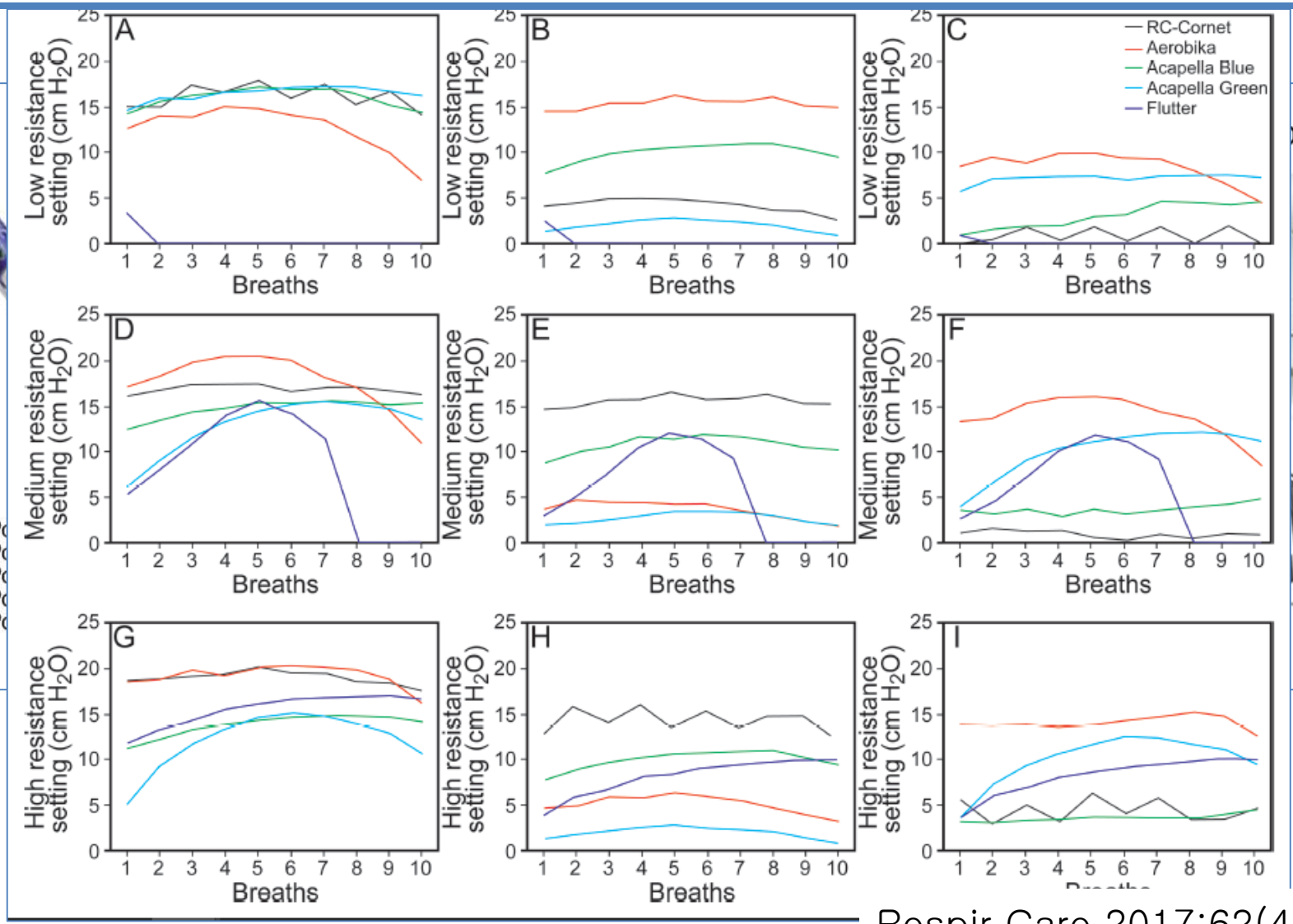
# Evaluation of Functional Characteristics of 4 Oscillatory Positive Pressure Devices in a Simulated Cystic Fibrosis Model

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International Journal of COPD

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ORIGINAL RESEARCH

# Cost-effectiveness of the Aerobika* oscillating positive expiratory pressure device in the management of COPD exacerbations

This article was published in the following Dove Press journal:
International Journal of COPD
19 October 2017
Number of times this article has been viewed

This study was sponsored by Trudell Medical International

**Table 3** Model base-case results

| Parameter | Aerobika* device | No PEP/OPEP therapy |
|---|---|---|
| Total direct medical cost | $7,829 | $8,382 |
| Total exacerbations (average #/patient) | 0.77 | 0.83 |
| Cost savings | $553/patient | |
| Number of exacerbations avoided | 0.06 (ie, six per 100 patients) | |
| ICER | Aerobika* device is the dominant strategy | |

# Other Approaches

RESPIRATORY INVESTIGATION 55 (2017) 276–282

Contents lists available at ScienceDirect

Respiratory Investigation

journal homepage: www.elsevier.com/locate/resinv

Fig. 1 – Tracheal vibration method. An electronic larynx

Original article

## A new method for enhanced expectoration of sputum by vibratory stimulation of the cervical trachea

*Mitsuhiro Kamimura, MD*, Nobuhisa Kameyama, MD, Chie Homma, MD, Tatsuya Ibe, MD, Shinjiro Takeoka, MD, Atsuto Mouri, MD, Yoichiro Hamamoto, MD*

The tracheal vibration method may be effective at removing central airway sputum and does not require repeated forced expiratory effort, which can otherwise cause exhaustion in patients with

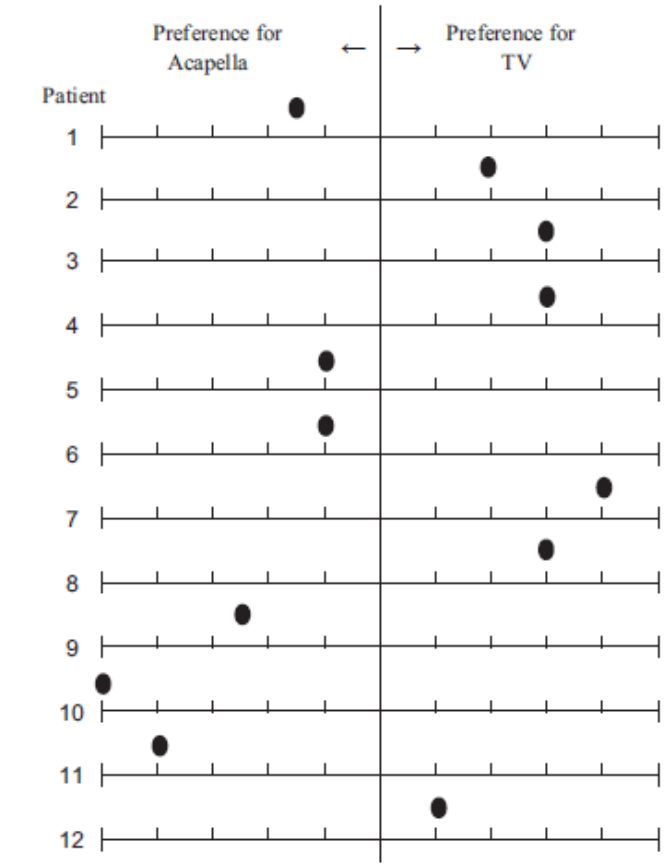


Fig. 3 – VAS ratings of the Yourtone and Acapella devices. VAS ratings for preference were assigned to each device by the patients.

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Journal of Critical Care

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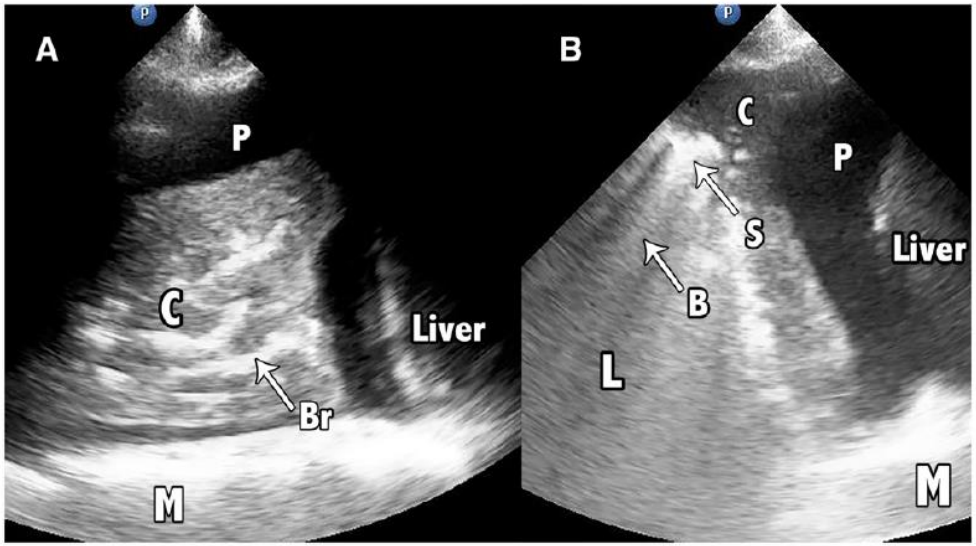
# Thoracic ultrasound: Potential new tool for physiotherapists in respiratory management. A narrative review☆,☆☆

Aymeric Le Neindre [a,*], Silvia Mongodi [b,c], François Philippart [a], Bélaïd Bouhemad [d,e]

- Currently accurate, reliable, sensitive, and valid measurements for the assessment of the indications and effectiveness of chest physiotherapy is lacking.
- Thoracic ultrasound may be a promising tool for the physiotherapist and could be routinely performed at patients' bedsides to provide real-time and accurate information on the status of pleura, lungs, and diaphragm.

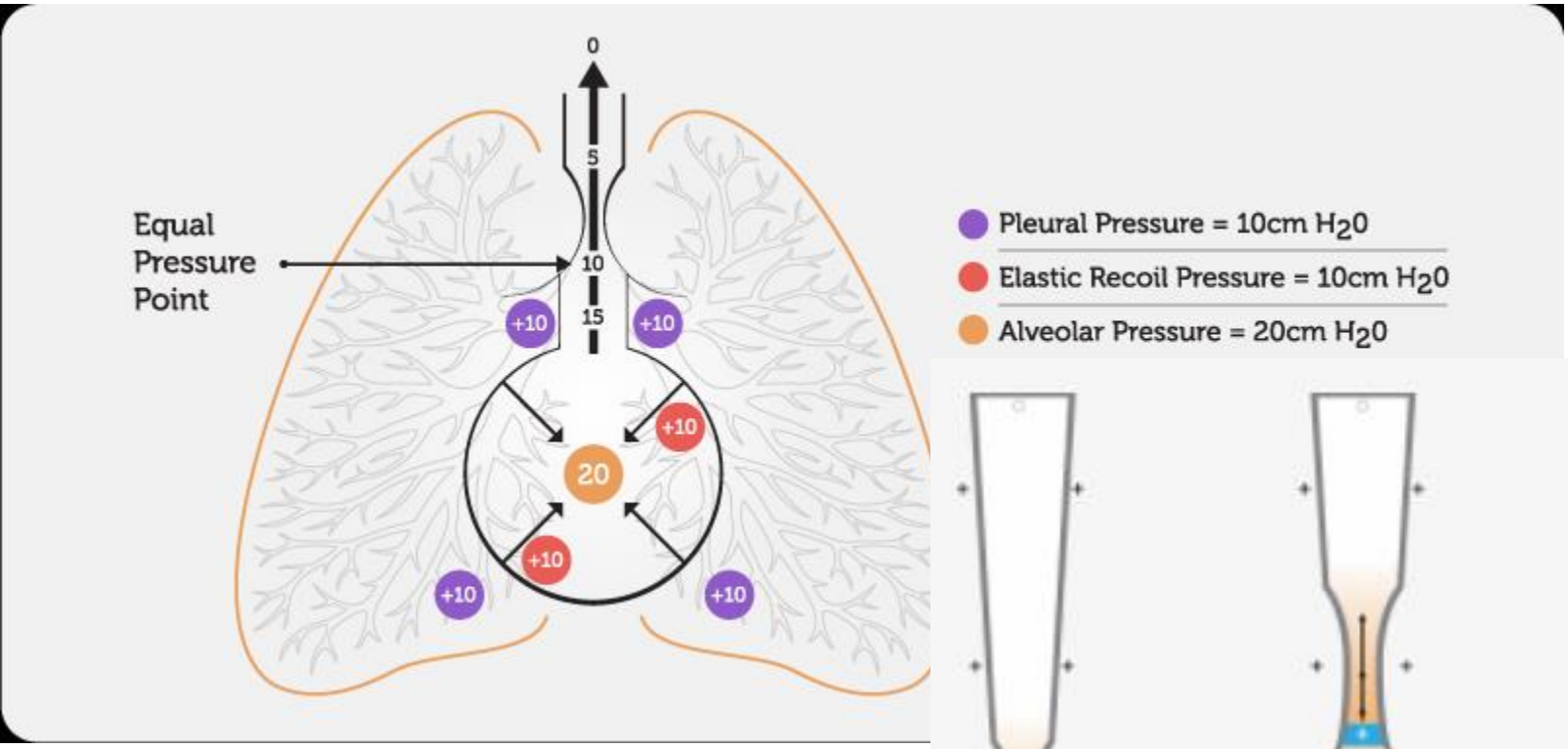


# Summary

- *Overview on Chest Physiotherapy(CPT)/ Airway Clearance Therapy(ACT)*
- *Clinical Evidence of Airway Clearance Therapy in Respiratory Diseases*
  - *Bronchiectasis*
  - *COPD*
- *Details and Clinical Evidence of Each Technique*
- ***Needs for more considering ACT in Respiratory diseases with sputum***

# Thanks for Your Attention!

# Huff (Forced Expiratory Technique)



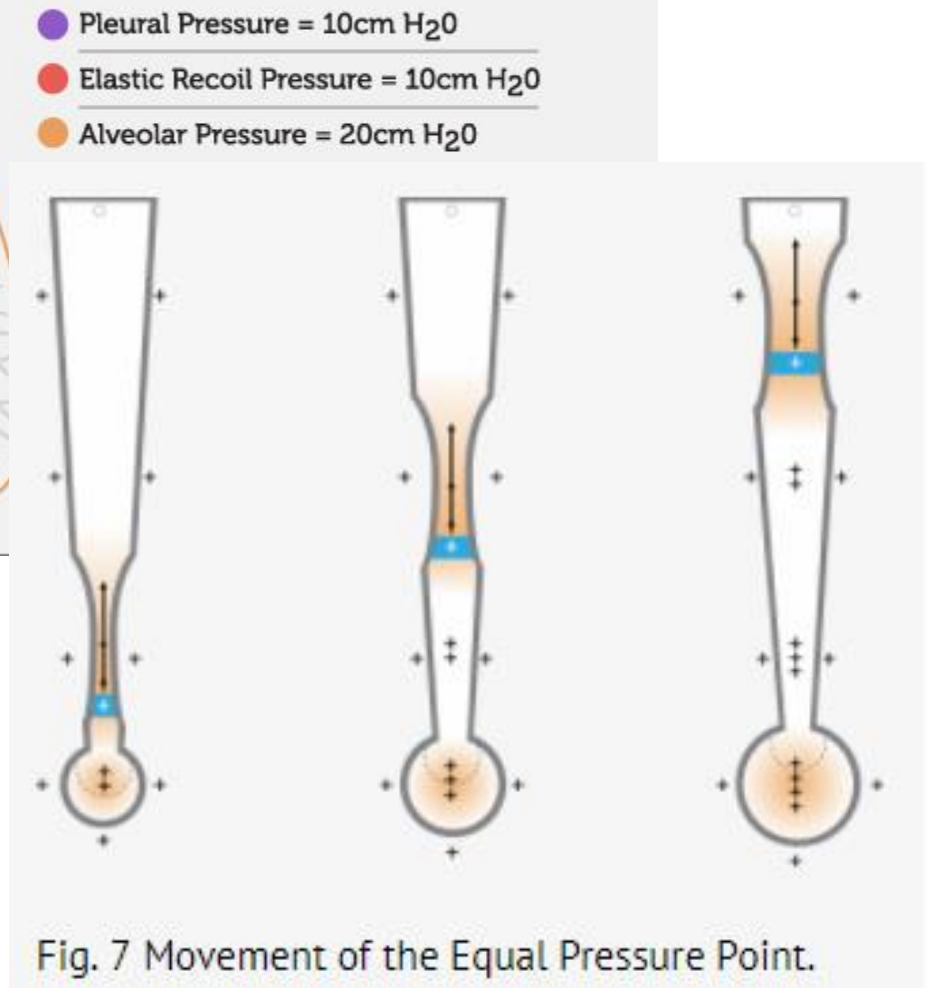




Fig. 7 Movement of the Equal Pressure Point.

# ACT effects on lung function

- Dynamic hyperinflation
  - HFCWO >>  cf. AD
  - Improving dynamic hyperinflation in HFCWO
- Static lung volume (TLC)
  - Airway oscillatory devices > ELTGOL

# Physiological basis for each ACTs

| | Ventilation | | | | Expiratory airflow | | Oscillation |
|---|---|---|---|---|---|---|---|
| | Interdependence | CV | Breath hold | Huffing[#] | PEFR/PIFR >1.1 | PEFR >30–60 L·min$^{-1}$ | |
| **Active cycle of breathing techniques** | Thoracic expansion exercises utilise interdependence | Thoracic expansion exercises utilise CV | Sometimes used with this technique if hypoventilating | Uses forced expirations at different levels | Ratio 2.8 | Average 302 L·min$^{-1}$ with huffing | No |
| **Autogenic drainage** | No | Yes, with breath hold | Uses 3-s breath hold with each breath | Only used to clear secretions from larger airways if needed | Yes; emphasis is on slow inspiration and increased velocity on expiration | 40–70 L·min$^{-1}$ Depends on level of breathing and degree of airway obstruction | No |
| **PEP** | No | As PEP is maintained within the airways over 12–15 breaths, use of CV is maximised | Not necessary as PEP is maintained within the airways over 12–15 breaths | Used at end of each cycle of 12–15 breaths | No<br>Ratio 0.47 | No<br>Average 26 L·min$^{-1}$ | No |
| **Oscillating PEP with Flutter** | Oscillations at 3–5 Hz may play a role, but frequency used in Flutter is >5 Hz | Yes with breath hold | Uses 3-s breath hold with each breath | Used at end of each cycle of 8–10 breaths | Ratio 1.15 | Average 68 L·min$^{-1}$ | 2–32 Hz<br>Most often uses 6–26 Hz |
| **Oscillating PEP with Acapella** | Oscillations at 3–5 Hz may play a role, but frequency used in Acapella is >5 Hz | As a PEP is maintained within the airways over 12–15 breaths, use of CV is maximised | Not necessary | Used at end of each cycle of 12–15 breaths | No<br>Ratio 0.64 | Average 35.4 L·min$^{-1}$<br>Within PEFR range needed, but would depend on viscoelastic and viscosity properties of secretions | 10–18 Hz |
| **HFCWO** | Oscillations at 3–5 Hz may play a role, but frequency used in HFCWO is >5 Hz | No | No | Interspersed with HFCWO | Yes, expiratory flow rate is much higher than inspiratory flow rate | Average 120 L·min$^{-1}$ | 5–25 Hz |

CV: collateral ventilation; PEFR: peak expiratory flow rate; PIFR: peak inspiratory flow rate; PEP: positive expiratory pressure; HFCWO: high-frequency chest wall oscillation. [#]: each technique incorporates huffing, as used in the forced expiration technique, with the exception of autogenic drainage.

Eur Respir Rev 2017; 26: 1600